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Dr. Jack Ammerman
Head Librarian
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September 3, 2009

Dear Dr. Ammerman,

There are, indeed, a number of BU faculty who have articles published in the BTI *Journal of Faith and Science Exchange* to which the BTI holds copyright. This letter confirms permission to digitize those articles written by BU authors for submission to your repository. You also have permission, as you request, to digitize all five volumes of the journal and host it as an open access platform. You will find articles there by other faculty members from additional BTI schools and numbers of their students, many of whom have gone on to do research and advanced work in science and religion areas.

In addition to the repository, I understand that you will be providing a journal publishing platform that will be used to host the journal. As you suggest, at some point we will want to link to this from the BTI web site.

I want to take this opportunity to thank you for providing broad access to the scholarly literature as well as a means of archiving the content in digital form from materials like these – and in this way and in this case to advance the science and religion discussion.

It is our hope to restart this journal, albeit in digital form. We will want to have further conversation when that happens.

Sincerely,

Rodney Petersen

Rodney Petersen
Executive Director

Cc/ Courtland Randall, Marian Simion, and the Trustees of the Boston Theological Institute

The Journal of Faith and Science Exchange

Volume IV, 2000

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The Journal of Faith and Science Exchange
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edited by
Barbara Smith-Moran, S.O.Sc.

with a foreword by
Gail Phillips Bucher, M.S.

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Editor's Note: As a matter of editorial policy, gender-inclusive language has been used throughout. (Exceptions are made for reasons of historical accuracy and for the treatment of gender-specific matters.) Scripture quotations, but not quotations from other source material, have been modified accordingly.

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Foreword

Gail Phillips Bucher, M.S.

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Men and women in faith communities realize that science and technology are part of our everyday lives. For twelve years the New England Center for Faith and Science Exchange (F&SE) and the Boston Theological Institute (BTI) have fostered the conversation between faith and religion and science and technology. Science-and-religion courses are included in the curricula of several of the BTI member institutions, and a Certificate Program in Science and Religion, a concentration that promotes dialogue between the two languages of human understanding, is also offered. F&SE administers the science-and-religion program and the Certificate Program in Science and Religion for the BTI.

F&SE, in conjunction with the BTI, also publishes an award-winning annual, *The Journal of Faith and Science Exchange*, one of two scholarly journals in the science-and-religion field. In 2001, its fourth year of publication, the *Journal* received the prestigious "Polly Bond Award for Excellence" from Episcopal Communicators. The *Journal* was established to spotlight the work of student authors of science-and-religion papers and to give them an opportunity to publish their work in a scholarly journal while still in graduate training. F&SE also issues *F&SE Notices*, a monthly newsletter of events and articles focused on faith-and-science interactions; and it sponsors conferences, seminars, colloquia, spiritual retreats and publishing contests for students in science-and-theology programs. The science-and-religion conversation is not limited to New England as evidenced by several other centers and organizations with similar focus around the country, such as the Center for Theology and the Natural Sciences, Zygon Center for Religion and Science, Philadelphia Center for Religion and Science, Institute for Religion in an Age of Science, and American Association for the Advancement of Science's Dialogue on Science, Ethics and Religion. F&SE is certainly in good company.

As science and technology have changed or expanded, so too has our concept of the world and the universe. Shepherds and travelers in biblical times used the stars in the heavens to guide them and could only wonder what lay beyond what they could see. Now astronauts and scientists send their instruments far beyond this planet and can view the world from a different perspective. Those with a web browser can view the earth or their neighborhood live from a satellite feed. Radio and x-ray telescopes send us images from deep space, even suggesting that there are other solar systems beyond our own. Whether one supports the Big Bang Theory or the Intelligent Design Theory, it is difficult to comprehend the vastness of all that is beyond this planet without a glimpse of the divine.

When we consider the advancements in other fields, in contrast to the vastness of the cosmos, it is often hard to imagine seeing or detecting things at the molecular, atomic, and subatomic level. We are way beyond Leuwenhoek's protozoan observations under a simple microscope. Medical technology has advanced so that detecting abnormalities and disease has become commonplace. New drug and treatment modalities save lives and allow people who once were considered hopeless cases to live productive lives. Mapping the human genome is only beginning to help scientists learn more about human life. As more and more healthcare professionals adopt spirituality into their holistic treatment, it is increasingly easy to believe that divine intervention enters into and fosters the healing process.

Somatic cell therapy, germ line therapy, cloning, xenotransplantation, and genetically engineered plants are just some of the scientific advancements and breakthrough technologies that raise, within religious circles, such ethical, moral and religious questions as, "Can we play God?", "Who benefits from these new advancements?" and "Are these new technologies safe for us and our children?" While these new technologies may be helpful in improving the quality of life, they do raise important questions and concerns, such as these, that reach to the heart of what it means to live faithful lives. Clergy need some level of understanding regarding these new technologies in order to counsel parishioners and to help them make informed decisions.

In faith communities, somatic cell therapy seems to cause less concern than germline therapy because the DNA changes are not inherited and are "corrections" specific to the patient being treated. However, germline therapy involves DNA changes that will be inherited and causes great concern for many religious traditions. Some will support inherited genetic modification *only* if it is therapeutic and *not* if it involves embryonic research. Cloning animals, and especially human beings, does not seem to be supported by most—and perhaps any—religious tradition. Xenotransplantation has also received attention in recent years. Some religious traditions have no problem with using animal parts from another species to improve the quality of life of human beings, whereas others prohibit killing one animal to prolong the life of another.

Genetically engineered plants have been suggested as a way to feed the hungry of the world because specially engineered plants could be more resistant to disease and pest infestation. Thus, higher crop yields will make more food available. Some would say that global food production without genetically altered crops is sufficient, but that economics, politics and distribution are the real issues. Multinational producers of genetically altered seed control the types and prices of seed, often giving farmers little choice in what and how much they plant. Some yields may be higher, but the long-term food safety issues remain unresolved. Meanwhile, the producers of the seeds are convinced that these modified foods are safe.

Caring for and protecting the ecosystems and the environment are also important for us all to consider. Global warming, biodiversity loss, overpopulation, pollution, topsoil loss and overconsumption are several issues that have political, social, religious and economic impact. Most people would not intentionally destroy the earth, but some lack knowledge regarding the impact of their habits, and others do not want any change in the status quo that might cause them social or economic hardship. Instead of blaming others for the condition of the world, perhaps more of us will be stimulated to take action if we learn more about the critical condition that

As new technology and scientific advancements emerge, the church may have to adjust the ways in which it fulfills its mission and change some of the traditional ways of teaching its beliefs. Religious leaders will need to have some scientific understanding to be able to communicate with parishioners and members of society in general.

affects our planet and our lives. To raise awareness regarding the need to be stewards of the creation, some churches are now including discussions, liturgies, prayers and hymns related to the environment.

Almost everywhere, we are touched by science and technology. We need leaders in the church to be able to be part of the science-and-religion conversation. As new technology and scientific advancements emerge, the church may have to adjust the ways in which it fulfills its mission and change some of the traditional ways of teaching its beliefs. Religious leaders will need to have some scientific understanding to be able to communicate with parishioners and members of society in general.

The BTI endorses adding a scientific component to theological education. For many years, several of its member institutions have included science-and-religion courses in their curricula. In 1999, the BTI Board of Trustees approved the BTI Certificate Program in Science and Religion in three tracks of study: Religion and the Natural Sciences, Religion and Bioethics, and Religion and Ecology. Likewise, the Certificate Program also provides an opportunity for those already scientifically or medically trained to develop greater sensitivity to theological issues and ethical concerns. In its first two years the Program has been highly successful and has awarded a total of six certificates. The Certificate Program does not presume to make seminarians into scientists. Rather, the Program exposes seminarians to scientific concepts and helps to give them a level of competency that will allow them to preach and teach in a scientific and technological society. Equipped with scientific understanding, these clergy should also ensure that scientific education is included at every level of parish education.

Volume IV of *The Journal of Faith and Science Exchange* may be considered a potpourri of science-and-religion essays and papers. The topics cover a broad range in the science and religion dialogue. For the first time, integration papers from the BTI Certificate Program in Science and Religion and papers from the Annual Science and Religion Colloquium are included. This volume also includes student essays from the Publishing Prize Contest in Science and Religion and papers from established scholars. Several student authors write about nature; others write about ethics, healing, theology, philosophy and artificial intelligence. **Wesley Wildman**, keynote speaker at the First Annual Colloquium in Science and Religion, suggests a roadmap for science-and-religion development at the beginning of the century; **Imad-ad-Dean Ahmad**, F&SE Tenth Anniversary Speaker, discusses Islamic contribution to modern scientific methods; and **Sjoerd Bonting**, F&SE 2000 Spring Lecturer, suggests connections between chaos theory and the creation of the world. We feel that the range of topics considered in Volume IV exemplifies the diversity in the science-and-religion field.

The science-and-religion field is multidisciplinary; it includes scientifically, theologically—and some scientifically *and* theologically—trained laity, clergy and theologians; they study and work in venues such as industry, academia, parishes, health care, law, centers for science and religion, and other national organizations. We at F&SE and the BTI are proud of our part in the continuing conversation between science and religion.

Introduction

Barbara Smith-Moran, S.O.Sc., Editor
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I am pleased and proud to announce that in April 2001 *The Journal of Faith and Science Exchange* received an Award of Excellence in the Polly Bond Competition, established in the mid-1970s to acknowledge excellence and achievement in church communication. The Competition is sponsored by Episcopal Communicators, to which I belong, an organization for communications professionals working in the Episcopal Church. The judges awarded the prize based on their examination of the first three volumes of the *Journal* (1997-99). Awards are given in a variety of publication categories, print, electronic, and broadcast. *The Journal of Faith and Science Exchange* received the highest award in the category of "Agency Publication that Best Exemplifies Its Mission."

And its mission is a crucial one for the growth and vitality of the science-and-religion field: to encourage and promote the careers of promising graduate students in this field by publishing their best work, alongside the work of more established scholars. The *Journal* remains one of the few publication venues for academics and professionals doing research, development, and application at the intersection of science and religion, and its unique promotional mission makes it stand out. We on the Editorial Board take this mission seriously, and the Polly Bond Award of Excellence suggests that we are doing our job very well.

This 2000 volume of the *Journal* spotlights the work of twenty-five students at graduate institutions worldwide. Three of them won Publication Awards in an international competition sponsored by the New England Center for Faith and Science Exchange: **Peter Heltzel** at Boston University, **Theodore Metzler** at Andover Newton Theological School, and **Kirk Wegter-McNelly** at Graduate Theological Union. Entries were judged by a team of independent judges, well known in the science-and-religion field. The winning essays and all the essays included in this volume come highly recommended by the faculty members who personally mentored the work. These faculty members comprise the 2000 Editorial Panel. In addition, we include essays by five established thinkers in the field: **Imad-ad-Dean Ahmad**, **Sjoerd Bonting**, **Paul Waldau**, **Olaf Dammann**, and **Wesley Wildman**.

Only a couple of decades ago, interdisciplinary research involving science and religion—including the study of science-religion interactions—was a rather narrow specialty with a few solo voices. By now, it has burgeoned into an diverse and busy field, as **Wesley Wildman** observes in his overview, which opens this volume. Around the world, many choirs of voices may be heard to sing an amazing variety of choruses. Their skill and influence are increasing, and the cultures that attend to them are the richer for it.

Under the heading of "Historical Studies," **Elizabeth Patton** is concerned to set straight a recent misrepresentation of the connection between the Protestant Reformation and the Scientific Revolution. **Imad-ad-Dean Ahmad** surveys the contributions of Islamic scientists to modern scientific practice and procedure.

The rest of the essays have been grouped according to the particular theological or philosophical topic each one illuminates with insights from science and technology. Under the broad heading of "Anthropology," **Theodore Metzler** and **Darrell Jackson** show how current AI and what might be called "AI hopes and dreams," respectively, are revising how the human condition is understood. **Jeannine Jacques**, **Robert Keefer**, and **Léon Turner** approach the topic from the psychological sciences, using different paths. **Kate Layzer** takes a social scientific look at sin, and **Paul Waldau** takes issue with the exclusion of the non-human animal sciences from the theology-and-science dialogues, especially those that maintain the habit of anthropocentrism.

Under the heading of "Creation and Divine Action," **Sjoerd Bonting** outlines a new way of thinking about God's original and continuing creation, with influence from chaos theory and complexity. **Chris Doran** writes of the weaknesses in some scholars' preoccupation to find where and when the divine hand touches the cosmos. **Mervyn Duffy** examines the history of the concept of zero, nothing, and how it has influenced theological thinking about creation. **Grant Miller Francisco** looks at the universe's emergent properties and the religious questions raised thereby. **Benjamin Milner** looks at Hawking's attempt to discredit two classical arguments for the existence of God.

In the category called "The Cosmos," **Kate Bitney** examines the basis for an Earth Ethics. **Forrest Clingerman** looks to a theology of culture, including history, to develop an understanding of nature. **Peter Heltzel** proposes that the "Two Books" concept has found invigorated theological standing. **Kirk Wegter-McNelly** examines the difference between two strategies for working out a theology of nature. **Carol Drummond** presents the views of several scientists on practical uses for the cloning of endangered species. **Nicole Roskos** exposes the influence of the "market god" in the development and dispersal of genetically engineered crops.

"Health and Healing" is the broad heading for three essays. **Olaf Dammann** discusses the recent results of studies on the religious factors that affect health. **Timothy Pawlik** encourages improvements in the guidelines for using human subjects in medical research. **Amy Wachholtz** reviews the differing stances of three religions toward xenotransplantation.

In the category of "Epistemology," **Marcy Wineman Axness** presents evidence for human modes of learning that are far more subtle than previously appreciated. **Thomas Carroll** looks at the role of mystical language and metaphor. **John Bradford Hooper** considers how the embodied mind seeks explanation. And **Udechukwu Anthony Emeka** demonstrates how a concept from theology can provide a model for fruitful relations between two fields of knowledge, science and religion.

One essay falls in the category of "God and Divine Nature." **Stephen Henry** imagines a conversation among non-contemporaneous scholars on the topic of mathematical and divine infinity.

In any field, the work of graduate students points the way to the future. This field is no exception. We are proud that the ***Journal*** has been recognized, by the Polly Bond Competition judges, for its effectiveness in fulfilling its mission to bring the best, most progressive thought of promising scholars to the attention of the wider interdisciplinary academic community.

The State of Science-and-Religion Scholarship at the Turn of the Century

Wesley J. Wildman
Boston University

In this keynote address to the 2000 Science and Religion Colloquium, the author not only describes and assesses the state of religion-and-science scholarship at the turn of the century but also proposes a new approach for guiding it into the new century. After surveying the multi-faceted terrain of recent research and identifying significant areas of current activity, Dr. Wildman forwards three theses regarding the future of religion-and-science scholarship. Such scholarship should make itself intelligible to the general public by avoiding methodological debates, employ multi-disciplinary resources in approaching research questions, and adopt a problem-oriented framework in handling complex, contemporary problems.

Introduction

In approaching the preparation of this address, I felt something like my oldest child on one occasion when he had gathered enough cash to make a Lego purchase and was studying a catalog. So many choices! And only so much money! In my case the precious commodity is time, which constrains the many appealing choices I have when approaching an address on the state of science-and-religion scholarship at the turn of the century. Well, Sam purchased a Crystal Scavenger Lego set and I made my decision, too. But I cannot resist the temptation to describe some of the delightful options, if only to underline the fact that there is nothing definitive about the approach I have chosen.

I will not give a formal history of the development of what some call a "discipline" of religion and science, though the journals, standard works, textbooks, funding, institutes, and degree programs are important signs that this is happening.

I will not give a systematic review of recent literature, though—or perhaps because—there is a vast amount of it in an enormously colorful array of themes.

I will not describe the state of play in religion-and-science scholarship in sociological terms, which would involve dwelling on the diverse groups that structure and define the research and teaching, the funding flow outwards from agencies that invest in the research, and the views universities hold toward interdisciplinary research of this kind.

I will not give a comprehensive survey of the territory of religion-and-science research, though I will mention a few examples of the fascinating work being done in many parts of the world on a host of topics.

Each of these approaches has its own special charm, but I shall proceed in another way. I intend to interpret the task of this address in a forward-looking way, which I take to have three aspects.

• "Looking around." I will begin with an unsystematic, incomplete, impressionistic "taking in" of the religion-and-science landscape, paying attention to both the research and teaching dimensions of scholarship.

• "Getting oriented." I will then give a critical assessment of this landscape in an attempt to identify significant landmarks and to indicate regions of activity that I think are peripheral or transient.

• "Moving forward." I will conclude with an argument on behalf of a way of thinking about the importance and usefulness of religion-and-science scholarship, a perspective that I believe is capable of guiding future scholarship in fruitful directions.

Looking around

I begin, then, with an attempt to describe the mass of interdisciplinary work in religion and science. I will take established disciplines as the principle of organization. Note that there is no possibility of completeness regarding either the nine disciplinary headings I have chosen or the three facets of each of the nine that I shall mention. A line of inclusion has to be drawn when the object of description is as rich as interdisciplinary work in religion and science. Note, too, that both theoretical and practical questions are entangled in every phase of this overview. That is why there is no separate category for ethics or metaphysics; they recur throughout.

I begin with the three disciplinary perspectives that have been most important historically. I do this partly because they are the oldest areas and partly to compensate for their neglect in most summaries of science-and-religion work.

Historical sciences

The modern scientific approach to analysis of historical materials has been the single most important contribution to new understandings of religious phenomena. Here are but three facets of this contribution with a few examples under each heading.

Historical studies of sacred scriptures: The last three hundred years of historical Jesus research is the direct consequence of emerging historical techniques. As new tools are developed for the historical critics' toolbox, new possibilities for trying to understand the figure of Jesus are discerned and exploited.

In many cases, the study of sacred scriptures has been inspiration for inventing or enhancing techniques of historical criticism. This was the case with the development of redaction criticism associated with the study of Judaism's Pentateuch or Christianity's Synoptic Gospels.

Far earlier than these developments in a number of traditions was the ongoing evaluation of the historical reliability of sacred scriptures. As an example, this sort of evaluation was a crucial component in South Asian philosophical debates within and beyond Hinduism about ways of knowing (*pramana* theory).

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Then as now, the scriptural and revelatory component of human knowledge is a weighty consideration in how religious traditions are to have a voice in public debate and also in issues of religious-cultural pluralism.

Origins and development of religious groups: Historical studies have defined the scholarly and to some extent the popular understanding of the birth and subsequent transformation of religious traditions. The story of how one of the many revolutionary Jewish reform movements led by one of the many Galilean Messiah figures became the official religion of the Roman religion is easy to tell incorrectly if distorting anachronistic, projective tendencies are not checked. Careful historical work has allowed for a relatively accurate portrayal.

The rise of anti-Judaism within Christianity and then anti-Semitism within medieval European societies has been analyzed to great effect thanks to scholarly historical methods. In light of the consequences of anti-Semitism, it might be argued that the historical sciences have made no greater contribution to the self-understanding of Western peoples than the tracing of the development of anti-Semitism, thereby raising consciousness and challenging its continuation.

Historical studies have also been vital for understanding the complex transformations that attend the migration of ideas and religious people. Consider the changes that accompanied the movement of Buddhism from South Asia into China and elsewhere in East Asia, the steady breakdown of tribal religions under the weight of large-scale organized religions, or the transfigurations of Islam as it spreads through Asia and Africa.

History of episodes in the relations of science and religion: The historical sciences have also made direct contributions to the understanding of episodes in the relations of the natural sciences and religion. The infamous Galileo episode is much misunderstood, but careful historical work has produced a balanced account of what happened. Likewise, Darwin's ideas and their reception have been clarified greatly thanks to patient historical scholarship. The influence of Einstein's metaphysical and theological convictions on his work in physics has been thoroughly documented. The ways that science itself serves what seems to be a religious or spiritual function for scientists such as Descartes and Faraday is now being investigated. And this is but the tip of a vast iceberg of existing and potential historical work.

Social sciences

In the last 150 years, the newly identified social sciences have been some of the most important allies of the historical sciences in transforming and deepening the understanding of religion. Examples of the contributions of three social sciences follow.

Anthropology: Thanks to anthropologists and their skilled observations of human cultural life, new perspectives have been gained on every kind of religious practice. The function of religious symbols and rituals has been analyzed to great effect, initiation rites have been described and related to developmental psychology, and the problems of describing and classifying religiously important social arrangements such as marriage or family have been amply documented.

Sociology: Building on anthropological data, the sociology of religion has been able to formulate theories of the origins of religious groups, of the mutual influence of religion and social organization, and of the complex linkage between ethical systems and religious practices. The sociology of knowledge, in particular, has met with great success in analyzing the function of religious ideas and practices in stabilizing and ordering human social life.

Economics: Beginning in the last third of the nineteenth century, the relations between religious commitments and economic interests have been analyzed with intriguing results. We have learned that religion plays a role in economies—regardless of our self-consciousness about this influence—and also that religion frequently serves economic interests.

Philosophy

The oldest of the sciences, philosophy has been the domain of attempts to think carefully about the world, spawning one specialization after another when the time is ripe. Leaving aside the role of philosophy in general, which in many cultures and thinkers is difficult to distinguish clearly from theology, philosophical specializations have made important contributions to the contemporary scholarly understanding of religion.

Philosophy of science: The philosophy of science has led to careful comparative analysis of social practices and conceptual patterns within the sciences and in religious thought. This methodological self-awareness has been the precondition for serious advance in debates about what is possible by way of relationships between religious and scientific activities. The philosophy of science has also made substantive contributions in the form of theories of causation and agency; these sorts of reflection decisively condition what can be said about themes such as divine action and the relation between the various disciplines of human inquiry.

Philosophy of logic: The philosophy of logic has permitted arguments about the existence of God to be studied using the formal languages of various logical systems and with a sophisticated awareness of presuppositions built into the use of formal arguments, presuppositions that express representations of the complex argumentative processes of human rationality. The need to grapple with arguments for the existence of God such as the ontological argument also has stimulated developments in logic, particularly modal logic, and in the interpretation of elements of formal logical systems.

Philosophy of religion: The philosophy of religion has made possible the systematic comparison of religious ideas and practices. This is no small feat because informal, impressionistic comparison is ubiquitous and hard to refine and improve. This advance has only been possible through the philosophy of religion's organization of the vast waves of data flowing from the study of religion.

Physics

I now move beyond these three classic disciplinary areas toward more clearly contemporary areas of interaction between the sciences and religion. Beginning with the most obviously mono-disciplinary area (physics), I shall consider in turn the biological sciences, the cognitive sciences, medicine, and ecology—each more interdisciplinary in character than its predecessor.

Physical cosmology: Boundary questions are questions prompted by scientific theories and discoveries but unanswerable within current science. The boundary questions associated with physical cosmology have been profound. Scientists have puzzled over these questions and pushed science to the limit in attempts to gain insight into them. The Big Bang theory even had some scientists convinced that a divine creation was a plausible explanation. Subsequent scientists showed that early scientific shock and religious enthusiasm about the Big Bang were both premature. There are now many speculative quantum cosmologies that make the Big Bang in one way or another not unique, thereby relaxing the tension that made the Big Bang seem so consonant with creation when it was first described.

Theological discussions of creation and eschatology have profited greatly from developments in physical cosmology. Big Bang cosmology in any of its versions conditions what theologies can plausibly say about the beginning and ending of the cosmos. Some theologies strive to formulate interpretations of creation and cosmology that are neutral to the details of physical cosmology by stressing the theme of dependence of the cosmos on God and steering a wide path around anything that might be construed as a prediction that future science could falsify. Even in these cases, however, current physical cosmology constrains what is said in negative fashion.

Other boundary questions have emerged. The fine-tuning of the cosmos is one that has provoked the most interest by defenders of religious commitments to divine creation. But the deepest questions may have to do with what science discovers about the metaphysical structure of the cosmos in terms of its constituents (wave functions? packets of probability?) and the laws of nature. These are ontological questions with significance for philosophical and theological interpretations of the deep structure of reality.

The philosophy of science has made substantive contributions in the form of theories of causation and agency; these sorts of reflection decisively condition what can be said about themes such as divine action and the relation between the various disciplines of human inquiry.

Quantum mechanics: This field has been slower than physical cosmology to impact theological reflection—and early responses were sometimes unsteady. This is partly because the general public works with largely classical scientific intuitions about the physics of the world, and it is these intuitions that are most commonly found among religious thinkers. It is also because there is still no consensus about the most adequate philosophical interpretation of the eerily accurate mathematical formalization of quantum mechanics. Under such circumstances, it is difficult for theologians to say very much. Lines of inference from quantum mechanics to theological themes always run through the metaphysical categories stabilized by consensus around the philosophical interpretation of the mathematical framework, consensus that is lacking, so far.

In a few circles, however, the religious interest in quantum mechanics has been pronounced. Taoism and Buddhism have been especially responsive to quantum physics because of its suggestion that the apparently unquestionably real world of ordinary experience is in fact quite misleading. Theistic religions sometimes have seen in quantum mechanics promise for articulating traditional beliefs about human freedom and non-miraculous divine action.

Complexity theory: Complexity theory is complex, which makes it difficult. But there is obviously something breathtaking about an intellectual venture that tries to show how complex organisms and processes can emerge in a drawn-out evolutionary process from the basic constituents and processes of the natural world. This catalyzes today an ancient debate about naturalism and supernaturalism, but for the first time in a way that is tractable for the sciences. That means proponents of supernaturalism can complain that naturalism is mistaken but that they can do nothing (short of gaining political control to suppress scientific research) to stop the investigations of complexity that promise or threaten to explain how plants and animals and people and ecosystems and civilizations emerge from the chaos of the early universe. Religious reactionaries opposed to scientific research have always lost when science has had tractable territory and progressive research programs with which to plow the ground.

The research programs of complexity theory are bold, to be sure, but there are several areas in which they threaten to overreach. The most obvious of these is consciousness, whose ontologically unique character is usually baldly neglected by scientists who content themselves with seeking physical correlations for conscious states while boldly writing books that purport to "explain" consciousness. The multidisciplinary area of consciousness studies seeks to correct this painful failure of intellectual propriety by bringing religious experts together with all manner of philosophers and scientists to address the issue. Another challenging area for ongoing research in complexity theory arises from within complexity theory itself in the form of attempts to give mathematical characterizations of intelligent design. This new research program has not yet proven itself in any detailed cases and may lapse eventually to the status of reactionary religious reformulation of the scientifically disreputable creation science. With time, however, intelligent design may produce challenging case studies that force changes in scientific research programs.

The theological interpretation of divine action has been heavily impacted by complexity theory. For example, there are now advocates of non-miraculous divine action through the means of whole-part constraint or top-down causation, which are modes of activity suggested by mathematical models of complex systems. Complexity theory has also directly impacted the philosophical understanding of emergence, which is vital for religious interpretations of human beings and the rest of the natural world, as well as for what it means theologically for God to have made the world the way it seems to be.

Biological sciences

Evolutionary theory: Leaving aside the culturally painful conflict of evolutionary theory and creation science, which is chiefly a North American phenomenon, there are many more constructive ways in which evolutionary theory has entered the science-and-religion dialogue. Theistic religions have struggled with the moral nature of a God who is supposed to have made the world in the way evolutionary theory suggests, a world in which mass death is essential for emergent complexity. Likewise, the idea of divine providence in all theistic religions has been challenged by the role of chance in the evolutionary process. On the other hand, scriptural and theological themes surrounding continuous creation and the immanence of God have been infused with new meaning in some religious circles because of evolutionary theory.

Human genome initiative: The documentation of the human genetic structure has received massive media attention for good reason: the research brings to the fore both the conception of human nature and a series of ethical challenges to do with responsible use of this knowledge. Religious thinking is heavily impacted by these developments because it is religious traditions above all that historically have formed human self-interpretations. Now it seems that scientific knowledge of human beings promises to bring the future evolution of the human species under significant human control, for good or ill. Are human beings ready for such fabulous powers of self-determination? Many religious traditions seem to warn against human pretensions to such god-like powers yet most sacred scriptures understand human beings to be specially blessed among creatures of the earth with the responsibility borne of knowledge. The road ahead appears to be a rocky one, and one whose safe travel will demand the very best of both religious and scientific wisdom.

Biotechnology: If the Human Genome Initiative has challenged conceptions of human nature in philosophical generality, then emerging biotechnologies, including those made possible by the Human Genome Initiative, have the same effect in concrete specificity. While many of these technologies are consonant with the traditional commitments of some religions to the sacredness of life, some challenge them. It is hard to complain about the health benefits of biotechnologies, but human ears growing on the backs of mice, artificially produced sheets of human skin for sale, and the enormous wastage of life involved in cloning all demand an explicit taking stock of exactly how far religions and societies are prepared to go. Making such decisions on the basis of former expectations about what is natural seems to be a mistake, yet the ethical criteria of "any means so long as the ends are good" does not seem right, either. Religious reflection and social debate have a long way to go in seeking a rational response to these new technologies.

Cognitive sciences

Neurophysiology: One of the leading contributors to the interdisciplinary adventures of cognitive science is neurophysiology. In one way or another, every religion has recognized that human bodies mediate the realm of spirit. The neurosciences sharpen this impression of mediation to the point that asserting the independence from the brain of any mental or spiritual function is no longer plausible. The neurosciences may not be able to explain the ontologically spectacular first-person quality of consciousness, but they have surely established that the brain is the seat of the soul. This is of enormous significance to the interpretation of religious experience, a theme of fundamental importance to most branches of all religions. It also has a bearing on the origin of religion itself, on the formation of personality type and religious preference, and on the question of the embodiment of soul or spirit. It is early days in this area of science-religion dialogue.

Linguistics: Linguistics understood broadly has been vital to the generation of the subtle theories of language that now exist. These theories are beginning to be used as resources for the interpretation of religious language, which is one of the most complex types of language use. Far more work is needed in this area but religious symbols and symbol systems promise to become fruitful objects of study in the years ahead.

Artificial intelligence: With the creation of machines whose programming allows them to act in ways that are similar to human behavior, questions about the limits and meaning of human selfhood are placed in sharp focus. Religious perspectives on human personhood are drawn into this picture and they are struggling to accommodate the new suggestions from AI research about what being a person means. AI also raises the question of human uniqueness, which in different ways has been a traditional affirmation of all of the major religions. Machines whose behavior is sophisticated enough to demand treatment as persons are a long way off but the philosophical and theological questions are already here.

Medicine

Spirituality and health: While east and south Asian traditions of medical treatment have always attended to the whole person, medical research in the West has only recently begun to pay attention to the relations between spirituality and health. Various dimensions of mind-body interaction are now well documented, from the relaxation response and the placebo effect, to the health advantages of religious people and the effects of meditation and prayer. The question of causation remains a subject of vigorous debate, but there is little serious doubt about the correlations. Here is one area in which religious wisdom has challenged a western scientific bias with some degree of success.

New medical therapies: New therapeutic possibilities promise previously unimaginable control over genetically inherited disease. Refined technologies have transformed care at the beginning and end of life. Life spans are increasing and new treatments for old diseases are constantly being invented. Wheth-er a person dies from cancer now depends more than anything else on access to good medical care—and the state of cancer research is changing so quickly that good medical care promises to make most types of cancer treatable before too many years have passed.

Apart from the problem of equal access to expensive medical care, no religious groups seem to be complaining about these medical advances. In other areas, however, things are morally more ambiguous. For example, xenotransplantation reframes conceptions of human nature because of its violation of traditional natural-law categories: a hybrid pig-human organ harvested from a pig and implanted in a human being is a problematic scenario for some religious people. The risks of disease associated with xenotransplantation techniques also remain difficult factors to assess responsibly, thus raising the specter of over-competitive scientists unleashing devastating retroviruses among human beings.

End-of-life care: Life after death, dementia and human identity, physician-assisted suicide and the sanctity of life—all of these issues and others like them confront traditional religious perspectives on growing old and dying. How do religious traditions take their bearings in a high-tech world in which the reach of medicine far exceeds the human moral grasp?

Ecology

Global ecology dialogue: Religion has played a significant role in facilitating public policy change in ecological issues in everything from the African tree-planting movement to Christian affirmations of the sanctity of nature. Moreover, religious commitments to justice have played important roles in assessing responsibility for ecological damage and repair. Religious forms of naturalism have been as important in these processes as have traditional religions. And because of the potential influence of religious groups over the imagination of religious adherents, religion will remain relevant to the global ecology dialogue for the foreseeable future.

Sustainability: Religion has also been a key factor in catalyzing a moral commitment to sustainability in energy policy and resource use. Yet the apocalyptic or other-worldly mindsets of some religious groups complicates work toward sustainability undertaken by others. This is one area where the religion-science dialogue can assist by helping religious groups to clarify and perhaps qualify traditional commitments to the primacy of the spiritual realm or to the inevitability of a new world to come.

The Big Bang theory even had some scientists convinced that a divine creation was a plausible explanation. Subsequent scientists showed that early scientific shock and religious enthusiasm about the Big Bang were both premature.

Crisis management: Ecological crises look to be on the increase, so crisis management will become an increasingly important concern in the years ahead. Religious views of distributive justice profoundly affect analysis of ecological crisis management and tend to balance the generic social preference for the haves over the have-nots with a commitment to the poor. In this case the science-religion dialogue involves in part mediating a prophetic vision of justice to the wider society. A world of ecological crises from rising sea levels due to global warming to unwanted side-effects of nuclear power and nuclear waste disposal promises to sponsor a view of the natural order as potentially hostile to human life, and thus as needing to be tamed through technology. Yet tribal religious perspectives speak more loudly and clearly here than the world religions: the problem is not nature but the way human beings choose to live. Can this insight of tribal religions play a role in keeping the science-and-religion dialogue focused on real options for the transformation of social policy so as to minimize ecological crises and maximize sustainability?

The neurosciences may not be able to explain the ontologically spectacular first-person quality of consciousness, but they have surely established that the brain is the seat of the soul. This is of enormous significance to the interpretation of religious experience.

Miscellaneous

In concluding this quick description of work in the religion-and-science field, I need some sort of miscellany to capture other themes that do not fit easily elsewhere. I am always pleased when the complexity of a reality being described forces a neat descriptive approach to collapse under the weight of its own pretensions; that is certainly the case here. Even with this miscellany, however, there is the problem of what to include within it, and I shall abide by my arbitrary limitation to three sub-themes. This does have one virtue, however: satisfying the requirement of a clear endpoint to this survey.

Pedagogy: There is evidently increasing interest not only in inspiring people to teach religion-and-science classes but in helping them to do it well. The John Templeton Foundation's cooperation with Berkeley's Center for Theology and the Natural Sciences in running a science-and-religion course program is the best example of this. This program has sparked controversy in the press, due to the perception that a private foundation is buying attention to an idiosyncratic "discipline" in colleges. But its value for those interested in science-and-religion teaching is unquestionable. Doctoral studies in science-and-religion are also expanding and becoming more sophisticated. Boston University, for example, offers even-handed training at the doctoral level in the sciences and humanities together with lab placements, innovative science literacy and religion literacy classes, and an array of interdisciplinary courses.

Method: Debates over method continue to be prevalent in the core science-and-religion literature and beyond, because people remain deeply concerned with demarcating domains of science and religion. I take this to be an extension of the human fascination with how we know, but the sense of urgency surrounding the issue derives from wider cultural issues. To understand the epistemology and method of the various sciences and the various sorts of religious inquiry is to gain a basis for debate over social processes, including who should be given a share of the precious social commodity of authority to speak on controversial subjects. Questions of comparative method are complicated by methodological diversity among the sciences, debates within philosophy and history of science over the methods implemented in actual scientific practices, and challenges from science studies to the effect that scientific "knowledge" is socially constructed and constrained like all other knowledge. Similar methodological chaos reigns among theologians and religious studies specialists. The core literature on method in science and religion is usually sensitive to this array of debates and thus tends to contain fairly sophisticated discussions.

Public interest: From New Age spirituality's embrace of popular science to richer journalistic coverage, the general public is more interested than ever in the interface of religion and science. This makes the area more attractive to some thinkers and less attractive to others! In my view of the relations between intellectual work and the wider society, scholars are obligated to assist the general public in achieving a rich view of the object of their interest, attacking oversimplification and supporting scholarly attempts to relate ongoing research to the public's practical interests. I think that the religion-and-science community has done a remarkably good job of discharging this responsibility over the years, especially with the cross-section of the public that is involved with organized religious communities. As time passes, it becomes more important to be able to work effectively with the media and new segments of the general public. Several initiatives aim to address this need, from the newly formed Science and Religion News Service to a variety of public lectures and popular videos.

Getting oriented

Describing anything is already to orient oneself to it in some ways because description involves decisions about what to omit and how to conceptualize whatever is mentioned. But orientation also involves identifying what is more or less important, fruitful, or promising. I make three remarks under this heading.

Richness of activity

Enormous variety of topics: The richness of activity at the interface of religion and science is most evident with regard to topics. An enormous number of research topics require input from both religious thinkers and one or more sciences. These topics divide roughly into the practical (ethics, social policy) and the theoretical (metaphysics, method). The list furnished in the "Looking Around" section above just scratches the surface; it is quite an amazing array of issues.

Enormous variety of approaches to each topic: Religious perspectives vary and interpretations of science vary, too. So when one considers any complex topic the variety of relevant approaches is itself quite large. Consider xenotransplantation, for example. The scientific debates cover everything from techniques to estimating the probability of encountering a retrovirus that could spread through the human population. Likewise, religious groups have quite different views of the limits and appropriate uses of such technologies. And the ethical considerations are complex and hotly debated, too, extending all the way into legal questions, public policy strategies, and stakeholder involvement. Only if all of these disciplines are involved in appropriate ways can a coordinated solution to the theoretical and practical challenges of xenotransplantation be developed. And the diversity is even greater in relation to other issues, such as the recent research on the impact of climate change on large cities, which involves all of the above specialties plus engineers, doctors, public sanitation experts, transportation specialists, and others.

Enormous variety of vocational entry points: People move into interdisciplinary work from any of the sciences, from any number of humanities disciplines, from an effort to make sense of a compelling personal experience that seems to require analysis from multiple disciplinary perspectives, or simply from a passionate concern about a problem that involves both the sciences and the religions. This means that the science-religion dialogue has a staggeringly rich array of interesting and curious people from many backgrounds. That can make dialogue extremely frustrating at times because such different people understand issues differently, judge the feasibility of research approaches in diverse ways, and make widely varying assumptions about what is plausible. By the same token, the diversity of vocational background makes coffee breaks and dinner conversations at science-and-religion events some of the most fascinating you'll find anywhere.

Ambiguity of activity

Occasional ignorance and arrogance: The description of diversity entails a number of difficulties within the science-religion dialogue. To begin with, participants are sometimes simultaneously ignorant and arrogant. I vividly remember an astonishing conversation with a well-known physicist whose ignorance of theological and philosophical matters was painfully obvious to humanists but who both assumed that expertise in a science automatically conferred authority in theology and philosophy and also evidently saw no reason to examine whether this assumption was justified. Interestingly, humanists these days tend to be more deferential toward scientists, perhaps because of the cultural hegemony enjoyed by science. It was not always so, however, and history books are rife with parallel examples of arrogance on the part of theologians and philosophers. This unfortunate conjunction of ignorance and arrogance is not found among the most experienced people involved in science-religion dialogue these days. Where it exists, it appears to be an understandable side-effect of extending habits of a home discipline into a new field and complicated by a lack of respect for disciplines less well understood than one's own. All would do well to avoid this difficulty.

Variation in skill levels: Another ambiguity in the science-religion dialogue is related to the first: those involved vary in both skill set and skill level. In most disciplines there is heavy social resistance to low-skill and low-quality work. In the science-and-religion field, by contrast, the situation is sometimes less demanding, creating the impression that "anyone can do this stuff." Similarly, in some areas and at some times, there are few signs of progressiveness in research, enthusiasm is often supported uncritically, and the dialogue environment is not highly competitive, so the usual social demands for scholarly excellence are weakened.

Neglect of core literature: The stress laid by many on a core science-religion literature is intended to address these problems. The "reinventing the wheel" syndrome is ever near both in method and in many key areas of dialogue. From time to time articles and books are published that exhibit an alarming neglect of the core literature. Standards are high among the most experienced science-and-religion scholars and improving elsewhere, even as the number of people involved increases rapidly. Knowledge of the core literature is crucial for maintaining solid standards and establishing a basis for discussion among diverse scholars.

Pervasive characteristics of activity

One-sided treatment of religions and sciences: Certain characteristics of the mainstream science-religion dialogue are pervasive. Most obviously, Western Christian interests have driven the dialogue for the most part. Religions other than Christianity and cultures beyond the West, however, have every bit as much to gain and lose at the interface with the sciences. This blind spot has been overcome in some areas better then others: ecology, cognitive science, and consciousness studies are the areas in which cross-cultural perspectives are most even-handed. Note that certain sciences also tend to be marginalized in the religion-science dialogue. Zoology and Veterinary Medicine are perhaps the most prominent among the neglected sciences, such is our casualness about nonhuman animals.

Too much method and yet not enough: The core religion-and-science literature pays a lot of attention to questions of method, sometimes to the point of obsession and sometimes to the neglect of content issues. Meanwhile, popular science-religion literature takes stands on method questions as if there were no extant debate over methodology (see recent books by Stephen Jay Gould and Edward O. Wilson, for example) and much actual research neglects methodological questions altogether. This pervasive feature of the science-religion area makes for a rather odd situation, with too much methodological discussion in some respects and not enough in others.

Fundamental importance of research questions: Another pervasive characteristic is thoroughly positive: almost all of the examples given above are cutting-edge questions of extreme importance to human self-understanding, to social policy and ethics, or to both at once. Science and religion are making simultaneous contributions to vital issues.

Moving forward

A scientist speaks out

Not so long ago, Lawrence M. Krauss, chairman of the physics department at Case Western Reserve University, wrote an opinion column for the back page of the *Chronicle of Higher Education*. Krauss argued that the recent enthusiasm for religion-and-science teaching and research attempts to bring the scientific and the spiritual aspects of human experience together, and that this attempt is misbegotten, its "results" intellectually vacuous. Religion and science have distinct domains; they should be respected for what they are while on their home turf, and incursions of one into the other should be resisted because they are essentially different and unmixable kinds of activities. He says:

> Science deals with ideas that are falsifiable. Religion deals with matters of faith. It is of vital importance for both fields that they stick to their separate turfs. In principle, they have virtually nothing in common. Whenever organized religion has attempted to dictate scientific ideas, from Copernicus and Galileo to Darwin, it has risked being proved wrong, and thus has diminished its intellectual standing.[1]

I have sympathy with this viewpoint when the question of relations between science and religion is posed in the abstract. The scientific and religious "attitudes", for want of a better word, do indeed seem to be different from one another to the point of being decisively distinguishable. Yet generalizations can mislead, particularly when they are so much neater than the reality they intend to describe. And Krauss's abstract statement of what counts as meaningful relations between science and religion is much too neat. Any amount of attention to the relevant details—even the cursory survey of research above—would suggest that Krauss has neglected to test his generalization against the relevant data.

Now, Krauss is a fine scientist and, in recent years, a hot-selling popular science writer and an interesting commentator on public policy matters bearing on science. But if you are going to go beyond social policy commentary, as Krauss did in this article, and attempt to resolve a complex methodological question without any trace of a reference to the existing literature on the subject, there is a good chance that you will slip up, no matter how intelligent and perceptive you might be.

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And slip up Professor Krauss did. In spite of my sympathy for his view of meaningful relationships between religion and science in the abstract—the literature calls its variants the "two-worlds", "two-languages", "separation" or "independence" models—the sheer volume of productive and intelligible scholarly activity in the science-religion area convinces me that Krauss's abstraction holds good only in special circumstances. The independence-of-domains thesis applies in some aspects of the relations between religion and science but by no means in every aspect.

This may be an example of what I earlier called the "reinventing the wheel" syndrome, with Krauss trying to make an interesting point without the benefit of thorough knowledge of the intricate debate surrounding the issue he wants to address. Fine; important pronouncements of respected scientists in the current era deserve the public's attention, at least to some extent. But Krauss's insight and the error of careless generalization associated with it are seen rather often—in recent years perhaps most notably in Stephen Jay Gould's *Rocks of Ages*, a strident defense of the independence thesis. This is a rather worrying trend and leads me to the first of three theses that I wish to advance as guides for moving into the coming years of scholarly work at the interface of religion and science.

Thesis I

Public understanding of religion-and-science is vital, but it is consistently stymied in this context by lack of understanding of inevitably subtle issues. A new approach is needed. Since public debate will rarely achieve much sensitivity to scholarly refinements, this new approach to understanding and speaking about scholarly religion-and-science work should be readily understandable and should sidestep methodological debates.

Importance of public understanding: The kinds of issues to which religion and science make joint contributions are important and often involve the public interest, particularly when the issues have social policy dimensions. The public determines social attitudes toward religion and toward science, and also influences political decisions about research funding and focus. Moreover, the spiritual questions that puzzle most people, whether members of formal religious groups or not, are impacted by research at the interface of religion and science. The science-religion dialogue needs to be responsible toward the general public in an effort to create fair-minded attitudes, to foster rational policy formation, and to connect ordinary people up with potentially helpful resources for their own spiritual journeys.

New approach is needed: Old approaches to conveying the significance of the religion-and-science dialogue for the general public are not working. They tend to be stymied by culture wars, such as the evolution-versus-creationism conflict, the risky-technology-versus-tried-and-tested-tradition conflict, and the who-holds-the-cultural-prestige conflict, each of which drives people towards vain attempts to insulate religion and science from each other. Getting beyond the distortion caused by these conflicts requires grasping distinctions and concepts that are too difficult for the average person—and evidently even many seasoned scholars—to understand without significant education focused specifically on the science-religion dialogue. A new approach to public understanding of science and religion is indeed needed.

Sidestep method: One constraint on new approaches to the public understanding of the science-religion field is that proposals must not be too complex for public debate in the mainstream media. Methodological issues are complex in just the wrong way for media discussion and public consumption. Focusing on methodology produces points of view that are too difficult to convey to the press, too difficult for the public to understand, or too abstracted from the obvious ways in which science and religion work together. Method should be downplayed, and the search should proceed for other ways to improve public understanding of science and religion.

Thesis II

In the current era, almost all of the interesting research questions must be approached using resources from multiple disciplines.

Complexity of contemporary problems: A basic fact determines the approach I recommend. Contemporary problems, whether theoretical or practical, are too complex for individual disciplines. It is complexity that drives the need for multidisciplinary approaches in ecology, biotechnology, cognitive science, philosophical anthropology, and even in theology.

Inevitability of multidisciplinarity: Multidisciplinarity, therefore, is inevitable. To respond to this inevitability, new kinds of training are needed, and new ways of imagining relationships among university departments. Without a relevant response to this inevitability, the problems will remain unresolved through the neglect or failure to win consensus vital for transformation of public policy.

Difficulty of multidisciplinarity: It is challenging to master even one discipline, let alone two. Colleges and universities need to begin training people in multiple disciplines earlier in life and with solid guidance. Genuinely difficult tasks often tempt one to take shortcuts, which is why people say that multidisciplinary approaches drive down standards. But the timelessly definitive character of this maxim assumes that training patterns stay as they are currently, and that the true multidisciplinary intellectuals must always be essentially self-taught. I think that multidisciplinary skills can be cultivated through a suitably conceived educational process. The past does not set the terms for the future in every respect; imaginative pedagogy and public communication can make a decisive difference.

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Thesis III

The new approach to understanding and speaking about scholarly work in the religion-and-science field should adopt a problem-oriented framework, stressing the need for interdisciplinary strategies for handling the complexity of contemporary problems.

Problem-oriented approach: A problem-oriented approach bypasses Krauss's legitimate concerns. Everyone, Krauss included, I expect, would admit that many problems require input of various kinds from many disciplines and social constituencies, including religion and theology, on the one hand, and the sciences, on the other. This approach also has the considerable virtue of making best sense of what is actually happening in religion-and-science scholarship. Of course, this approach is not limited to religion-and-science but is an entire attitude to real-life problem-solving that seeks a closer relation between theory and practice.

Philosophical basis for problem-oriented approach: This approach is useful for simplifying and increasing effectiveness of discourse in the public square and it is descriptively more adequate to the actual kinds of research being conducted, but these are far from the only reasons to adopt it. Biologically grounded philosophical theories of inquiry begin from the adaptive fit between the conundrums faced by animals and their ability to solve those problems effectively. This is especially true of human beings who are preeminently problem-solvers. The philosophical position commonly called pragmatism, so far from affirming crass utilitarianism, enshrines this biological interpretation of human beings in a unitary theory of inquiry (one world, one way of knowing). The problem-solving conception of relations between disciplines, including religious reflection and the sciences, can draw solid support from pragmatism.

Cash value of this approach: In following this approach, one learns to think of science and religion not in terms of dialogue between disciplinary centers, but in terms of joint work on common projects with a variety of disciplines called upon as needed. The assumption that religion and science should work together obviates the need to make the case for cooperation; attention turns away from fights over disciplinary privilege and intellectual turf (with which Krauss and Gould concern themselves), to the far more important challenges, whether they be practical or theoretical in character, whether they be matters of profound curiosity about the world or threats to the vitality of the ecosphere and the very survival of the human species. To be sure, one can pick up methodological debates as points of curiosity at some point along the way, nuancing the views of Professors Krauss and Gould with insights from the core religion-and-science literature, if so desired. But these methodological questions need not be settled before all manner of problems can be tackled head-on, cooperatively and creatively.

In short, this problem-oriented approach to religion and science changes the way it is discussed in the public square; it bypasses turf conflicts that squander energy better spent on dealing with urgent problems, it transforms the vision of how to educate children and research students, and it stresses the relevance of the intellectual life for practical affairs. And it does all of this at a time when intellectuals can no longer afford to stay in their ivory tower of mono-disciplinary security.

Every power—including those powers that derive from expertise in science and religion—must be bent to address the challenges now bearing down. The past, present, and future of the religion-and-science field are pointed in a most promising way toward just such a transformation in self-understanding.

Works cited:

Gould, Stephen Jay. *Rocks of Ages: Science and Religion in the Fullness of Life.* New York: Ballentine, 1999.

Krauss, Lawrence M. "Point of View. An Article of Faith: Science and Religion Don't Mix." *Chronicle of Higher Education* (26 Nov. 1999).

Wilson, Edward O. *Conailience: The Unity of Knowledge.* New York: Vintage Books, 1999.

Endnotes:

1. Text available online, at <http://erebus.phys.cwru.edu/~krauss/14a08801.htm>

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The Excellency of Theology: A Critique of Robert K. Merton's "Puritan Thesis," with Reference to the Works of Robert Boyle

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Robert K. Merton's "Puritan Thesis" asserts a direct correlation between Puritan theological beliefs and participation in natural philosophy (what today would be known as science). This essay corrects the misleading assumptions and conclusions brought about by Merton's argument, by using the writings of Robert Boyle. Boyle, whom Merton designated a "Puritan scientist," wrote extensively on the connection between natural philosophy and theology; and his writings demonstrate that the relationship between the two was far more complex than the simplicity of Merton's thesis suggests.

The nearly contemporaneous occurrence in European history of the Protestant Reformation and the "Scientific Revolution" has led many historians to attempt to link the transformations of religion and science together. For example, some have argued that Protestant theology promoted or made more attractive the empirical and experimental philosophy that attained dominance in the seventeenth century. One of the more long lasting, and perhaps one of the more misleading, of these theories about Protestantism and Science is the so-called "Puritan Thesis" of twentieth-century American sociologist Robert K. Merton. In the essay, "Puritanism, Pietism and Science," Merton asserts that Puritans were attracted to and pursued science to a greater degree than their contemporaries, because of the tenets of their specific theology. Merton states:

> [T]he Puritan ethic, as an ideal typical expression of the value-attitudes basic to ascetic Protestantism generally, so canalized the interests of seventeenth century Englishmen as to constitute one important element in the enhanced cultivation of science.

Merton goes even further with the argument:

> The deep-rooted religious interests of the day demanded in their forceful implications the systematic, rational, and empirical study of Nature for the glorification of God in His works and for the control of the corrupt world.[1]

Merton's thesis, accurate or not, has had a very long reach. Many people still have a vague idea that the strict, highly industrious and serious tone that supposedly characterized Puritan life led many of them to become committed practitioners of natural philosophy.[2]

Besides propagating an oversimplified and, in many ways, inaccurate conception of the Puritans and their beliefs, Merton's use of the views of various seventeenth-century natural philosophers as evidence for his thesis has led to the incorrect categorization of many of these individuals as definitively Puritan. One such figure to whom Merton repeatedly refers to in this context is Robert Boyle. In this essay, I address two of the major difficulties with Merton's thesis, by using the example of Robert Boyle and his writings on the relationship between natural philosophy and theology. Firstly, I demonstrate, by a succinct examination of what a Puritan is, that the definition of Puritan used by Merton in the essay is misleadingly over-generalized and inconsistent. This inconsistency means that Merton's thesis is unable to provide an accurate insight into the complexity of views on theology and natural philosophy held by figures like Robert Boyle. Secondly, I will apply the four tenets of "Puritanism" that Merton identifies as being correlated to natural philosophy to two of Robert Boyle's works on the relationship between theology and natural philosophy. Applying Merton's markers of Puritanism to a close reading of Boyle indicates that, far from articulating views on the relationship between natural philosophy and theology that indicate a strong Puritan preference, Boyle instead drew a boundary between natural philosophy and theology that was expressly non-sectarian and general. Boyle's theology and his relation of it to natural philosophy was not demanded or generated by the project of natural philosophy nor of "prevailing social values" as Merton would like to argue.[3] Rather, as Boyle himself said:

> I am not a Christian because it is the Religion of my Countrey and my Friends.... I admit no mans opinions in the whole lump, and have not scrupled, on occasion, to own dissents from the generality of learned men, whether Philosophers or Divines: And when I choose to travel in the beaten Road, 'tis not because I find 'tis the Road, but because I judge 'tis the Way.[4]

The complicated views of individuals like Boyle regarding natural philosophy and science do not fit into the neat matrix of "Puritan" or "Anglican," and a picture of seventeenth-century science and religion contingent on such categories fails to reveal the complexity of the English historical situation. Merton's failure to examine in detail the thoughts of the individuals he was anxious to classify as Puritans means that, in nearly all cases, he used such a blunt instrument of description that he missed the rich complexity of the reality in which men like Boyle operated. In letting Boyle speak for himself, the competing tensions that many natural philosophers experienced, caused by both religious conservatives and philosphic liberals, emerge with a clarity and immediacy that Merton's use of statistical categories fails to capture. (In this essay, I have always used the seventeenth-century terms "natural philosophy" and "natural philosopher," as the terms "science" and "scientist" are modern and, therefore, as applied to the seventeenth century, anachronistic.) In addition to the two stated goals, my very approach in this essay, then, serves as an indirect methodological critique of Merton's dependence on statistical calculations of such categories as educational background and Royal Society membership to support his thesis of a causal link between Puritanism, Pietism and science. As the case of Robert Boyle shows, fortunately or unfortunately, historical figures often defy strict categorization, a fact that makes the successful application of the sociological tool of statistics quite difficult to achieve.

Defining the Puritans

The Puritans constituted an important force in seventeenth-century England. Historian John Spurr describes the time:

> England's stormy seventeenth century was the puritan century, the era of the "puritan revolution" when civil war and revolution ushered in government by the saints, and Protestant nonconformists emerged as an undeniable and ineradicable social and political force.[5]

But just who were these people called Puritans, who wielded such influence in England? I will not attempt to provide an all-encompassing definition of the Puritans here, as it is a project far beyond the scope of this essay; but a brief overview is important to correcting some of the problems of Merton's argument.

The label of "Puritan" has a long and varied history. From its earliest usage, in the latter part of the sixteenth century, as a mocking insult suggesting self-righteousness and hypocrisy, to its later anti-monarchical political implications in the seventeenth, "Puritan" as a term has carried with it numerous and different stereotypes.[6] These stereotypes also extended to actions or attitudes that allegedly sprang from Puritan beliefs. Various historians have sought to define Puritans in a way that goes beyond these kinds of broad generalization, focusing on the Puritan's spiritual self-identity, rather than on what they did. David Sceats describes the Puritans this way:

> ...those committed to pushing to its logical conclusion the programme of reform in the English Church initiated in the time of King Edward VI, but interrupted by Queen Mary's reign of terror.[7]

Puritans were in favor of thorough and real reform, but for the most part mainstream Puritans did not advocate separating from the Church of England. Their concern was the reform of the English church from within, and most Puritans abhorred the label of "Separatist." Their commitment to reform was in some cases radical, but not to the degree that it wished to subvert the entire structure of the Anglican Church. As historian Patrick Collinson describes, Puritans could be distinguished from their English Protestants neighbors by "everything that separated real from merely formal Protestants."[8]

Most of the historical literature on Puritans focuses, as John Spurr notes, on what Puritans did, whether that was lobbying for the reform of the Elizabethan church in the early seventeenth century, leading a political reform in the course of the Civil War and Interregnum, or sustaining their community in the years of persecution during the Anglican reaction after the restoration of the monarchy. This tendency to define Puritans based on their response to their circumstances has meant that it often appears impossible to define just what a Puritan is, since their description is seemingly contingent on their environment at a particular historical moment. Yet Puritans throughout the seventeenth century did have a common spiritual heritage, which, although it underwent change, still kept as its main aim the pursuit of individual salvation as well that of the English Church at large. Both a strong strain of rational analysis and the experience of the heart characterized Puritan spirituality —Puritans sought to find in themselves the marks of grace as evidence of their election. Such marks could only be recognized through the work of grace upon the heart, but the understanding of the work of grace could only come through reasoned meditation. Ascertaining these marks of grace was central to puritan theology, for it linked directly with the doctrine of Election, the idea that some were predestined for salvation, while others were damned. Only God truly knew who was assured and who was not, but individuals could gain assurance by finding the signs of grace in their own lives. Thus, "the hope and desire for [election], the awareness of it, and the assurance of it, were fundamental to the Puritan religion."[9] For this reason, much of puritan literature, sermons and otherwise, is preoccupied not only with impressing upon the audience the importance of receiving grace, but also with the intricate analysis of such heartfelt experiences; for the Puritans were in no way pure spiritualists, and faith without reason was no faith at all. What links Puritans together across the seventeenth century was this theology which combined reason and empirical spiritual experience centered on the pursuit of individual salvation. In his history of seventeenth-century English Puritanism, Spurr writes:

Boyle argued that natural philosophy simply cannot encompass the divine, and to argue for a theology and a God that can be totally grasped through the application of reason to the natural order is arrogantly to overreach the limits of human reason.

> We should remember that the goal of English puritans was not literary monuments, nor was it political power: it was the kingdom of heaven.... [W]hat they did, what they achieved, was in their own eyes ultimately less important than why they did it and who they were: God's people.[10]

In light of this description of the Puritans, how do Merton's uses of the term compare? Merton claims in a preface to his essay to be using the term Puritan to designate all Protestant groups in seventeenth-century England, a use he deemed acceptable, because he believed that all such groups shared a core set of religious and ethical convictions (a dubious proposition at best). Such a generalization is far outside the historian's ordinary use of Puritan, for which Merton excuses himself, saying that his interest was "social rather than ecclesiastical."[11] Yet within his essay, Merton definitely uses "Puritan" to designate a much narrower band of English Protestants, particularly with regard to the membership of the Royal Society, a scientific society officially founded after the restoration of the monarchy in the 1660s. His equation of the terms Protestant and Puritan has been shown to be a great oversimplification, as has his argument that the majority of members of the Royal Society had Puritan affiliation.[12] The reality of post-Restoration English religion, characterized as it was by the Anglicans and numerous "dissenters"—Independents, Presbyterians, Quakers, with those who might be called Puritans spread across the spectrum of these sects—means that many of the individuals Merton wants to single out as Puritans, such as Robert Boyle, do not fall into any neatly definable sectarian or theological category.[13] Nor can all of these different Protestants be easily classified as "pro-" or "anti-science" in a simple sense. All of the members of the Royal Society shared an interest in science, but how they worked out that interest in relation to religious convictions or lack thereof was different for each individual.

So, in some sense, Merton's use of "Puritan" is shorthand for Protestant, and even more than that, it is shorthand for a set of social values that he saw operating in seventeenth-century England. Merton noted four major tenets of "Puritanism" that directly linked natural philosphy and theology: (a) the presence of an immutable law which must be discovered and obeyed in both the order of nature and in that of theology, (b) the relationship between empiricism and rationalism, (c) the theological requirement for industry so aptly filled by natural philosophy, and (d) the utility of both pursuits.[14] Do these four tenets match up with the ideas of the natural philosophers that Merton is discussing?

In the following sections, I apply in turn each of Merton's four "Puritan" tenets to two works by Robert Boyle that deal specifically with the relationship of natural philosophy and theology: *The Excellency of Theology, Compared with Natural Philosophy* (1674), and "The Christian Virtuoso" (1690). The former was written as an extended letter to a "friend" who, having been lead astray by the fleeting glories of natural philosophy, had failed to give theology its proper place of primacy in the pursuit of knowledge. The latter was written by Boyle with the intention of demonstrating that natural philosophy and theology were not incompatible, and that there was no inconsistency between being a "virtuoso" of natural philosophy and a Christian.

In Boyle's framework, God's revelation to the individual, not immutable divine law, is paramount for both natural philosophy and theology.

Boyle was born in 1626 and died in 1691. He is perhaps best known for the law that bears his name, relating the pressure and volume of gases. He lived through the English Civil War and the Restoration of the monarchy, with all the concomitant religious transformations. Although Merton labels him a "moderate Puritan," it is difficult to ascertain what this would mean or where Boyle fits in among the many Protestant sects of the time. He did, as historian of science Reijer Hooykaas notes, have several influential non-conformist friends, such as Thomas Syndenham—a physician with connections to Oliver Cromwell—and John Eliot, who would later become a missionary to North American Indians. He also did write, during his teens, a narrative of his conversion, a type of biographical writing common among more stringent Protestant sects such as the Puritans. Yet, like many in the post-Restoration era, in which the Restoration church settlement left many so-called non-conformists both inside and outside the Anglican church, spread among various groups, Boyle does not fit any one sectarian category easily.[15] Boyle was, Merton states, "one of the scientists who attempted explicitly to link the place of science in social life with other cultural values."[16] Boyle did not see himself mainly as a natural philosopher, but as an individual who pursued natural philosophy as part of a larger quest after whatever knowledge of the divine was graspable by human reason. While some of his writings were, as Merton terms them, "apologia[s] for science" to religion, in many of his works Boyle was equally—if not more—concerned with maintaining the distinct superiority of theology to natural philosophy.[17] He was not only one of the foremost natural philosophers of his day, but also, Hooykaas notes, "takes his place among the eminent apologists of Christian religion."[18] In these two essays, especially in *The Excellency of Theology, Compared with Natural Philosophy* (hereafter referred to as *The Excellency of Theology*) Boyle did make a case for the connection between natural philosophy and theology, but is was not made to legitimate natural philosophy to the theological community, as Merton's thesis argues. In the following sections of the essay, I will show that Boyle's aim in making the connection between theology and natural philosophy was to re-establish the primacy of theology, to which natural philosophy was a subordinate, if important, pursuit.

God's immutable law: the common foundation of Boyle's theology and natural philosophy?

One prominent connection between "Puritanism" and natural philosophy made by Merton is that both entail belief in an "immutable law." In religion, Merton states, Puritan theology asserted the immutable law of predestination, under which the fate of an individual's soul was predetermined and set by God. In science, this immutable law was that of the divine order of nature, which could be discovered through experimental philosophy, but not altered or manipulated. Both natural philosophy and theology were, in a way, deterministic; and through the devoted study of natural philosophy, one could continually acknowledge the divine law which had created the order of the natural world.[19] This link of immutable law is the baseline for Merton's "Puritan" science. Protestants, because of their theology of the absolute law of predestination, were required to engage industriously in the world, interpreting their spiritual experiences both rationally and empirically. Through the continuous evaluating of spiritual experience by reason, individuals could hope to determine whether they bore the marks of God's grace, a sign of their individual salvation. The study of the order of nature and of the immutable laws underlying it was an ideal arena for this interaction between industry and empiricism. Merton is correct to draw attention to the link between the immutable divine law of nature's order and the interests of Protestants in pursuing its study. Robert Boyle echoed the position Merton has described when he writes in *The Excellency of Theology*:

> But as the two great Books, of Nature and of Scripture, have the same Author; so the study of the latter does not at all hinder the study of the former.

The study of natural philosophy can even lead the mind "directly to the acknowledgment and adoration of the most intelligent powerful and benign author of things," Boyle stated in "The Christian Virtuoso."[20]

Yet, while the immutable law of God's natural order is a part of Boyle's understanding of the relationship between theology and natural philosophy, it is not the cornerstone. Boyle did accept natural philosophy as able to discern substantial knowledge about God through the rational study of nature; yet such a religion was, for him, insufficient and, in the end, unsatisfying. In *The Excellency of Theology*, Boyle argued that natural philosophy simply cannot encompass the divine, and to argue for a theology and a God that can be totally grasped through the application of reason to the natural order is arrogantly to overreach the limits of human reason:

> So although bare Reason well improv'd will suffice to make a man behold many glorious Attributes in the Deity; Yet the same Reason, when assisted by Revelation, may enable a man to discover far more excellencies in God, and perceive them, that he contemplated before, far greater and more distinctly.[21]

Merton's statement that natural philosophy and theology were linked for "Puritans" because both were founded on immutable divine laws does not reveal the logic that underlay Boyle's integration of the two. For Boyle, natural philosophy and religion were related on the basis of what each could offer to the individual, not in Merton's sense of the theological demand that each individual take responsibility for personal salvation and, thus, pursue the study God's creation, but rather in the sense of the elevation of an individual closer to knowledge of the divine will. As Boyle wrote in *The Excellency of Theology*:

> [The individual may] know something of the Nature of God by the Light of Reason, yet we must owe the knowledge of His Will or Positive Laws to His own Revelation.[22]

And later in the text Boyle wrote:

> [Through revelation, God shows] there are Discoveries more valuable than those which relate but to the Objects that he has expos'd to all men's Eyes.[23]

Individuals can and should study nature to discover which attributes of God are contained therein, but such a contemplation of nature is incomplete without the addition of God's revelation, as may be found through the scriptures and the study of theology. In Boyle's framework, God's revelation to the individual, not immutable divine law, is paramount for both natural philosophy and theology.

Rationalism and empiricism in Protestant theology and science: identical or parallel concepts?

In Merton's argument, science and theology are linked not only by the two forms of divine immutable law, but also because both are founded on a combination of rationalism and empiricism. For Merton, these ideas also connect science and theology through the ideas of the Protestant work ethic and of utility, tenets of "Puritanism" that I examine below in two sections of this essay. Theologically, Puritanism did have both rational and empirical strains. Puritans, although undoubtedly influenced by earlier scholastic theology, liked to described their theology as "practical affectionate divinity" which was, "a theology that engaged with—indeed arose from—experience, context and situation, seeing itself as the handmaid of godliness."[24] Spiritual experience required rational analysis to be understood, but reason without empirical experience permitted only a superficial understanding.

The two forms of empiricism contributed to two levels of the understanding of the divine; spiritual empiricism the truths about God's own nature and will, natural philosophical empiricism data about God's order of nature.

Merton is correct in saying that there was a link between empiricism in natural philosophy and in spiritual experience. Both placed strong emphasis on the individual's gaining insight through direct personal experience. Spiritually, one could truly know God only through a direct experience in which God touched the heart. Philosophically, true knowledge was gained by actually observing and measuring the data oneself. Yet beyond this shared emphasis on the real presence of the individual, the theological and philosophical concepts of empiricism were rather different. Boyle's emphasis on revelation demonstrated the key distinction between the two:

> Reason cannot discover Truths [about God] but when Revelation once sufficiently propos'd them to Her, she can readily embrace and highly value diverse of them.[25]

Revelation could, in the form of spiritual experience, provide the material of Divine Truths, which could be shaped by reason, whereas empirical natural philosophical experience could provide observations and data by which reason could construct hypotheses about the natural world. The two forms of empiricism thus contributed to two levels of the understanding of the divine; spiritual empiricism the truths about God's own nature and will, natural philosophical empiricism data about God's order of nature. Philosophical empiricism was insufficient, as God could not be seen only with a "Philosophical eye"; and Boyle argued that, as a result, far better conceptions of God had been "penned by fishermen and early Christians" (who placed a greater premium on spiritual empiricism) than by most Greek, Roman, and Chinese philosophers.[26] Rather than being a double application of an identical concept, as Merton argues, in Boyle's *The Excellency of Theology*, the meaning of the link between rationalism and empiricism takes two distinct but parallel paths, in religion and natural philosophy respectively. Rationalism and empiricism did link natural philosophy with theology in Boyle's eyes; but again, the theological version of the relationship, emphasizing the centrality of the empirical experience of the reception of revelation, was the superior one.

A shelter from sin: natural philosophy and the "Protestant work ethic"

"The combination of rationalism and empiricism which is so pronounced in the Puritan ethic forms the essence of the spirit of modern science," Merton states, and this link between science and theology is also evident in the related theme of the "Puritan work ethic." The rigorous application of reason to empirical experience would ensure that individuals did not fall prey to the temptation of sin. The demand of Puritanism for "systematic, methodic labour," and "constant diligence in one's calling" matches perfectly to experimental natural philosophy, with its requirement to study all aspects of nature empirically, Merton claims. The eschewing of idleness by Puritans as a means of avoiding sinful temptations again is a natural fit with the demands of experimental philosophy. Rather than being tempted by vice, one can occupy oneself with experiments.[27] *The Excellency of Theology* does have some references to these advantages of natural philosophy. Boyle noted that God gave human beings reason, "which permits the study of Natural Philosophy by its exercise," and in doing so, they may come to a greater knowledge of God's attributes.[28] Again, though, Boyle deemed natural philosophy insufficient both as a means of obtaining knowledge of God and as a motivator for worthwhile industry and guard against temptation. For in Boyle's eyes, the contemplation of theological truths increased the piety and virtue of the contemplator. He wrote:

> [Studies of Divine truths] not onely Restrain One undue Passion, but Advance all vertues, and free us from all Servile Fears of the Deity: and tend to give us a strong and well-grounded Hope in Him.[29]

For Boyle, natural philosophy was not the primary source of valuable occupation, but it did elucidate a method that, if applied to theology, could render it even more valuable. "Nor do I doubt, but that a much greater progress might be made in the Discovery of Subjects where, though we can never know all, we may still know farther," Boyle stated, when speaking of theology. Rigorous analysis was far more productively applied to theology than to natural philosophy:

> [If] Speculative Geniuses would proposed to themselves particular Doubts

> and Enquiries about particular Attributes, and frame and examine Hypotheses, establish Theorems, draw Corollaries; and (in short) apply to this study the same sagacity, assiduity and attention of mind which they often employ about inquiries of a very much inferior nature [a far more comprehensive knowledge of God could be achieved].[30]

The focus of one's industry should be rational analysis of God's revelation, to which natural philosophy might contribute some insight into God's natural order or a method of analysis. For Boyle, theology remained as the dominant partner in relationship to natural philosophy.

The usefulness of theology compared to natural philosophy

Experimental philosophy was a means of earnest activity, but activity that was of service to the world. This melded, according to Merton, with the "Puritan" bias against the withdrawal of monastic life and their spiritual goal of "the good of many." In short, Merton argues, "science embodies two highly prized values: utilitarianism and empiricism."[31] Boyle did see natural philosophy as useful, but its primary utility was in pointing individuals towards a greater acknowledgment of God's glory. This argument is especially clear in "The Christian Virtuoso," where he stated:

> And indeed, the experimental philosophy giving us a more clear discovery, than strangers to it, of the divine excellencies displayed in the fabrick and conduct of the universe...very much indisposeth the mind, to ascribe such admirable effects to so incompetent and pitiful a cause as blind chance, or the tumultuous justlings of atomical portions of senseless matter; and leads it directly to the acknowledgment and adoration of a most intelligent, powerful and benign author of things....[32]

Merton rightly notes that the need for industrious occupation that would enable the individual to glorify God is one link between the utility of natural philosophy and religion; yet what is striking in the Boyle texts is his relative weighting of theology over natural philosophy. In *The Excellency of Theology*, Boyle wrote of using a "balance" to "show that [natural philosophy's] Excellencies, though solid and weighty are less so than the prepondering ones of theology."[33] Theology not only drew one more closely into an understanding of the divine, but also had ends and goals that were ultimately far more useful than those of natural philosophy.

> The Benefits which men may receive from the Divine, surpass those which they receive from the Naturalist, both in the Nobleness of the Advantages and in the Duration of them, [for] the boasted use of Natural philosophy, by its advancing Trades and Physick, will still be to serve the Body; which is but the Lodging and Instrument of the Soul.[34]

Theology, thus, could always claim to be the supremely utilitarian object of study, for it alone dealt with the true nature and state of the soul. Natural philosophy, in Boyle's mind, was indissoluably linked to theology, as it gave the individual a greater understanding of God's attributes; but it was never sufficient unto itself to provide full theological understanding.

Boyle was concerned with those who professed belief in the veracity of the scriptures but for whom a natural philosophy without divine revelation had come to assume a place of primacy in explaining the world.

What of Merton's claim that "Puritans" were particularly concerned with "the good of many" and were, thus, united with Francis Bacon. Bacon, according to Merton, believed in the power of science to improve the "material condition of man," which, "apart from its purely mundane value," was "a good in the light of the Evangelical Doctrine of Salvation by Jesus Christ."[35] Boyle had his suspicions about the benefits that could be generally derived from natural philosophy. Whereas the study of theology benefited all individuals equally, natural philosophy was less egalitarian. Many improvements that resulted from the work of natural philosophy "prejudiced one sort of Men as much as they Advantage another." [36] Natural philosophy had its own particular uses, but theology was the source of universal improvement and, thus, had superior value.

> Just as the skill of a jeweller is preferable than that of a mason because of the nobleness of the object [where we know upon tradition the value of jewels over common stones], so a more dim and imperfect knowledge of God, and the Mysteries of Religion, may be more desirable, and upon that account more delightful, than a clearer knowledge of those Inferior Truths that Physicks are wont to teach.[37]

Boyle believed that natural philosophy gained its true utility only when inspiring the individual toward the study of theology, a pursuit that would always generate truths far superior to those discovered through natural philosophy.

Boyle's project: re-establishing the priority of theology

If, as Merton's thesis argues, the seventeenth century was the age of "Puritan science," why did Boyle bother to write such lengthy expositions of the relationship between theology and natural philosophy? One would suppose that the natural philosophic community, if dominated by "Puritans," would be in full agreement with his arguments for the supremacy of revealed theology, thus rendering his project superfluous. Boyle's essays depict a picture of the natural philosophic community that differs from Merton's thesis. In his preface to *The Excellency of Theology*, Boyle lamented:

> The undervaluation of the study of things sacred is not his [a friend's] fault alone, but is grown so rife among many (otherwise ingenious) Persons, especially Studiers of Physicks, that I wish the ensuing Discourse were much less seasonable than I fear it is.[38]

Directly in contrast to Merton's argument that natural philosophers were chiefly concerned with making natural philosophy acceptable to a dominant theology, Boyle stated that it was students of "Physicks," in particular, who were prone to demoting theology below natural philosophy. Natural philosophers had fallen prey to undervaluing theology, because of

> ...a certain secret Pride, grounded upon a Conceit, that the Attainments of Natural Philosophers are so noble a kind and argue so transcendent an Excellency of Parts in the Attainer, that he may justly undervalue all other Learning, without excepting Theology itself.[39]

But notable in Boyle's comments is his stress on the undervaluation of theology. Boyle was not writing to atheists, agnostics, or skeptics, for if he were, Boyle stated that his argument would have been different, focusing much more on scriptural proofs. Boyle was concerned with those who professed belief in the veracity of the scriptures but for whom a natural philosophy without divine revelation had come to assume a place of primacy in explaining the world. Theology was being subsumed into natural philosophy, rather than being maintained as superior. He was, thus, not seeking to demonstrate the religious value of science to an atheistic community, but rather to combat what he saw as an insufficient natural theology, and to reconfigure the relationship between natural philosophy and theology.

Boyle's specific focus, as evidenced by his repeated references to "your friend Descartes" in addressing the intended recipient of *The Excellency of Theology*, was on those followers of Descartes who were described as deists. Deism in Boyle's time, as Hooykaas notes, is "customarily defined as the doctrine that God gave the world its laws and left it to its fate," although there were many deists who did "acknowledge God's constant concern for creation." [40] Perhaps a better definition of deists would be the following: those who neglect "revealed religion [and] argue that the natural light (i.e., that of reason) is sufficient to arrive at pure religion." [41] Natural philosophers who subscribed to this view believed they could arrive at all sufficient knowledge of God through reason and study of the natural world. God's revelation outside of that of the natural order, thus, had little importance. Descartes was often taken as a model in this strain of thought, with his rational arguments for the existence of God, which could be arrived at by human reason alone. Natural philosophy, for Descartes' followers, assumed a place of primacy among other types of learning, not because naturalists were atheists or skeptics, but because their view of religion put such a premium on natural theology, or on that which could be discovered by a combination of rational and empirical study of nature. Boyle sought to reassert the importance of the rational and empirical study of theology. Spiritual experience and revelation were two key elements of theology that could not be grasped through the study of nature. In these two essays, Boyle strove to prove that reason alone was insufficient. In *The Excellency of Theology*, Boyle constructed a brief dialogue between himself and his imagined audience of deists. He argued that the immortal nature of the soul could be ascertained only with assurance through God's revelation. "Yet didn't Descartes demonstrate the immortality of the soul by reason only?" Boyle's imagined audience asks. No, Boyle would answer, for all the Cartesian proof offers is a rational demonstration that the soul is distinct from the body, not that it continues on after the destruction of the body. For Boyle, such a proof is an example of the failure of natural philosophy to match the elevation offered by theology and divine revelation. The Cartesian proof, he wrote, is good for "Atheists, Epicureans and other men, Naturalists who will not allow God to have anything to do in the case." [42] For natural philosophers who profess to be Christians, it was insufficient, and presented a flawed relation between natural philosophy and theology.

At the heart of Boyle's arguments was his desire to maintain the proper connection between the two, in the face of the dangerous conflation of theology with natural philosophy offered by the deists. The natural theology expounded by the deists marginalized theology into the mere partner of philosophy. What Boyle was arguing against, in one sense, was the secularization of natural philosophy suggested by the deist conception of the relation between natural philosophy and theology, with its devaluing of revelation. One of Boyle's chief concerns was to define "the natural philosopher" in such a way that interest in theology was not only a permissible, but an integral part. "Men can be philosophers who also study Divine Learning," Boyle stressed in *The Excellency of Theology*; natural philosophers should not be limited to the study of natural philosophy.[43] As Boyle argued:

> [I am] no Lecturer or Professor of Physicks, nor have ever engaged myself by any Promise made to the Publick, to confine myself, never to write of any other subject. Nor is it Reasonable, that what I did or may write, to gratifie other mens Curiosity should deprive me of mine Own Liberty, and Confine me to One Subject.[44]

Boyle wished to restore the relationship between theology and natural philosophy to one where theology was universally accepted as the cornerstone discipline, so that natural philosophers' interest in theology could only enhance their natural philosophic work.

In "The Christian Virtuoso" and in *The Excellency of Theology*, Boyle argued for natural philosophy and theology to be integrated; but he did not advocate a relationship in which theology became simply another basis for the rational methods of natural philosophy, as deists who argued that God could be found purely through reason and the study of nature did. In his "Puritan thesis," Merton correctly distinguishes several points of correlation between natural philosophy and theology, but his conception that men like Boyle were chiefly interested in making natural philosophy acceptable to their faith leads him to misunderstand that governing belief in Boyle's case was theology, rather than natural philosophy. Boyle valued natural philosophy highly, but the determinant element in the relation of natural philosophy to theology was theology. Natural philosophy and theology did share the idea of an immutable law, but it was revelation, for

Boyle, that set the place of natural philosophy in relation to theology. Empiricism and rationalism were needed in faith and philosophy, but spiritual empirical experience and rational analysis of revelation would bring assurance of the most important Divine truths. Industry and utility could be practiced in natural philosophy, but through theology one's work was elevated and the results made ultimately useful. In all aspects, it was theology that determined the role of natural philosophy in Boyle's understanding of the connection between the two, a role which was always of secondary importance relative to that of theology. Boyle's arguments did not demonstrate a particular sectarian agenda, nor an advocacy of the profession of natural philosophy to the religious community, despite what Merton's thesis would suggest. His chief concern was to maintain a meaningful position for theology in light of the growing encroachment of a more secularized natural philosophy. Instead of the work of a "Puritan" natural philosopher, Boyle's writings can be seen as an early contribution to the long-lasting and broader debate over the propriety and nature of the relationship between theology and natural philosophy.

Works cited:

Boyle, Robert. "The Christian Virtuoso." In *Science and Religious Belief 1600-1900*, ed. by D. C. Goodman, 121-28 Dorchester, England: John Wright and Sons, in assn with the Open University Press, 1973.

_____. *The Excellency of Theology, Compared to Natural Philosophy.* London: Henry Herringman, 1674.

Collinson, Patrick. *The Elizabethan Puritan Movement.* London: Jonathan Cape, 1967.

Hall, A. Rupert. "Merton Revisited, or Science and Society in the Seventeenth Century." *In Science and Religion: A Selection of Recent Historical Studies*, ed. by C. A. Russell, 56-73. London: University of London Press, 1973.

Hill, Christopher. *Society and Puritanism in Pre-Revolutionary England.* London: Secker and Warburg, 1964.

Hooykaas, R. *Robert Boyle: A Study in Science and Christian Belief.* Lanham, Md.: University Press of America, 1997.

Hunt, Richard M. *The Place of Religion in the Science of Robert Boyle.* Pittsburgh: University of Pittsburgh Press, 1955.

Hunter, Michael. *Robert Boyle: Scrupulosity and Science.* Suffolk, England: The Boydell Press, 2000.

Merton, Robert K. "Puritanism, Pietism and Science." In *Science and Religion: A Selection of Recent Historical Studies*, ed. by C. A. Russell, 20-54. London: University of London Press, 1973.

Morgan, John. "The Puritan Thesis Revisited." In *Evangelicals and Science in Historical Perspective*, ed. by David N. Livingstone, D. G. Hart, and Mark A. Noll, 43-74. Oxford: Oxford University Press, 1999.

Sceats, David. *The Experience of Grace: Aspects of the Faith and Spirituality of the Puritans.* Cambridge: Grove Books, 1997.

Spurr, John. *English Puritanism 1603-1689.* London: Macmillan Press, 1998.

Wojcik, Jan. "The theological context of Boyle's *Things above Reason.*" In *Robert Boyle Reconsidered*, ed. by Michael Hunter, 139-55. Cambridge: Cambridge University Press, 1994.

Endnotes:

1. Merton, p. 20.

2. Merton uses the term "science," although in a true historical sense this is anachronistic, as the term science was not used in its current sense until the nineteenth century. In discussing Boyle's views, I have always used the term "natural philosophy," but when directly discussing Merton's assertions I have maintained his use of the term science.

3. Merton, p. 25.

4. Boyle, quoted in Hunter, p. 57.

5. Spurr, p. 1.

6. Hill, p. 20.

7. Sceats, p. 4.

8. Collinson, quoted in Sceats, p. 4.

9. Spurr, p. 159.

10. Spurr, pp. 202-203.

11. Morgan, p. 64, n. 11. Morgan's essay is a thorough analysis of the historiography that has developed around the Puritan thesis, coupled with an attempt to authenticate Merton's thesis by applying it to the writings of numerous individuals who, by today's historical standards, are designated as "true" Puritans.

12. For example, see Hall, and Morgan.

13. Ibid., p. 48.

14. Merton, pp. 24-25, 28.

15. Ibid., p. 44. ("[T]he climate of values most conducive to and interest in science was found among the moderate Puritans, as exemplified by Robert Boyle"); Hooykaas, p. 10; Spurr, p. 131. It is interesting to note that in other discussions of Boyle's religion and science, Boyle is identified as orthodoxly Anglican. See Hunt, where he asserts that the "allegiance to Anglican theology made it 'philosophically' possible for Robert Boyle to pursue his studies in 'natural philosophy'" (p. 57). Apparently one person's "moderate Puritan" is another's "orthodox Anglican." which is perhaps unsurprising, given the confused nature of post-Restoration English religion.

16. Merton, p. 21.

17. Ibid.

18. Hooykaas, p. 57.

19. Merton, 28-29.

20. Boyle, *The Excellency of Theology*, p. 121; "The Christian Virtuoso," p. 125.

21. Boyle, *The Excellency of Theology*, p. 5.

22. Ibid., p. 6.

23. Ibid., p. 182.

24. Sceats, pp. 11-12.

25. Boyle, op. cit., p. 15.

26. Ibid., p. 5.

27. Merton, p. 25.

28. Boyle, op. cit., p. 68.

29. Ibid.

30. Ibid., pp. 89, 94.

31. Merton, pp. 24-25.

32. Boyle, "The Christian Virtuoso," p. 41 (p. 125 in the anthology).

33. Boyle, *The Excellency of Theology*, p. 115.

34. Ibid., p. 132.

35. Merton, p. 24.

36. Boyle, op. cit., p. 133.

37. Ibid., p. 160.

38. Ibid., author's preface.

39. Ibid., p. 164

40. Hooykaas, p. 6. An example of Boyle's designation of Descartes as "friend" or "your favourite" is found on p. 144 of *The Excellency of Theology*.

41. Ibid., pp. 3, 6.

42. Boyle, op. cit., pp. 25-27, 36.

43. Ibid., introduction.

44. Ibid., author's preface.

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Islamic Contributions to Modern Scientific Methods

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The author suggests that the rise of modern science was not a revolutionary development confined to modern Europe, but an evolutionary process that began in the Islamic civilization. He reviews those elements of the Islamic religious outlook that appear to have transformed science from the deductive methodology of the ancient Greeks to the inductive approach of modernity. Finally, he suggests that the supposed inherent tension between religion and science is a consequence of the sudden exposure of medieval European culture to the "new" scientific paradigm that had evolved in the Muslim World.

The idea of a dialog between faith and science is viewed somewhat differently in the Islamic world than it is in the modern West. For Islamic society, especially during the classical Islamic era about which I shall primarily speak, the same word, *'ilm*, was used for both religious and scientific knowledge. Indeed the pre-Islamic era was called the *jâhiliyya*, or "Age of Ignorance." In my book, *Signs in the Heavens: A Muslim Astronomer's Perspective on Religion and Science*, the main theme is that the presumed tension between religion and science is a modern Western phenomenon, an anomaly in the history of the world, definitely not part of Islamic thought.

I wish to address the Islamic contributions to the modern methods of science. Note that I will concentrate on the "methods" and not on the body of knowledge, although I will make some reference to that. Most people are aware that there is a distinction between modern science and ancient science, but I doubt that most understand the precise nature of that distinction. I wish to identify those differences because it is my contention that it is the Islamic civilization that developed the elements that are the key positive differences between ancient science and modern science.

There is no doubt that there was an ancient science. Anyone can look back in history at the names of the great Greek and Roman scientists. While many of their ideas have been discredited and much of their data has been superseded, that isn't a criticism of what they did, because modern science supersedes its own theories and data on a regular basis. Yet there is a fundamental difference between what they did and what is considered to be modern science. In particular, I think that the most important difference is one of epistemology. Epistemology is the theory of knowledge, the answer to the question, "How do you know what you know?" The stereotypical ancient scientist is Aristotle. Aristotle identified the essence of doing science as understanding why everything is as it is on the principle that it could be no other way. This concept is a reflection of an epistemology that I call rationalism. "Rationalism" is a word that gets used with many different meanings to different people. I want it to be very clear, therefore, that when I use the term "rationalistic science" I mean neither science that employs reason nor science that insists upon an adherence to reason. I mean a science in which reason is considered to be the dominant means for the acquisition of knowledge, in which reason overshadows—if not completely replaces—any other means of the acquisition of knowledge. What this meant to the ancient Greeks was that if one began with the correct axioms, the correct premises, the correct starting points, that, by reason alone, one could completely deduce the nature of the universe. Modern science doesn't work that way.

Modern science works by what some call "the scientific method" and others say should be called "the scientific methods." Some call it "inductive science" or "inductive reasoning." Any really intelligent high school student could explain that modern science involves not only reason, but also observations of experiments. The idea is that reason must match observation, and theories must be tested by experiments, and that there is a great cycle in which theories inspired by observations are tested by experiments that lead to refined theories to be further refined or overthrown by yet more experimentation or observation.

Yet, this is only two-thirds of the story. There is another element of modern science that never gets mentioned. Since the existence of this third element as a method of modern science is undeniable, I can't help but think that the reason that it never gets mentioned is that people want to contrast modern science against the way of thinking that dominated the Middle Ages—and here I mean the Western European Middle Ages—that was more authoritarian. What Western European moderns viewed Medieval thinking to be was parodied by Molière in his play, *La Malade Imaginaire* (*The Hypochondriac*). The character of the doctor still had a medieval way of looking at things, and the doctor would begin every analysis with the introduction: "Aristotle dit..." ("Aristotle says..."), as if the fact that Aristotle said something constitutes a proof. Yet, referral to authority is an important element of the acquisition of scientific knowledge for all modern scientists. Most of what any scientist knows about a discipline, he or she has read in the scientific literature. Scientists do not check every detail of every theory upon which their own work is based. Scientists do not attempt to reproduce every experiment on which their data is based, nor do they duplicate every observation upon which their work is based. Scientists resort to the scientific literature and they incorporate, adopt, and build upon what they find there. Yet there are two important differences between the way the modern scientist uses the scientific literature and the way in which the medieval scientist approached the sacred or ancient scientific texts, the "ancient wisdom." Above all, modern scientists approach the literature *critically*; they do not assume that it is beyond question. And secondly, they require proper citation.

While many of their ideas have been discredited and much of their data has been superseded, that isn't a criticism of what they did, because modern science supersedes its own theories and data on a regular basis.

Even in ancient times, individual scientists can be found who seem very modern in their approach. Archimedes, for example, has always impressed me in this way. Nonetheless, the first civilization to nurture and produce a modern approach to science in which all three of these elements (reason, experiment or observation, and critically approached and properly cited authority) was the classical Islamic civilization. It was there developed in a gradual way. Westerners tend to look at it as a "scientific revolution" that took place in Western Europe: it was very abrupt, and very shocking in its effects on the culture. My understanding is that the West discovered it through their contact with Islam, and because it was thrust upon them so suddenly, it did indeed have a shocking effect on Western society.

Let me return to Islamic science. The popular view in the West is that there was an ancient science that got lost and was then rediscovered and transformed into modern science by the West. The most one can hope to find in an American high school textbook is a statement along the lines of "The Arabs preserved the ancient science." It is as if Muslims had done the West a favor to serve as curators of their science until they could get back to developing it.

In the intellectual community, the historians of science are more sophisticated. They understand that there was scientific research done during the Muslim era; but even on this, they are divided on its significance. Some think that it was little more than caretaking. They know that knowledge was not simply preserved; but some intellectuals think that what was added was not anything of great importance, just details and flourishes, a few data points and minor refinements to the theories of the ancients. There are others who will admit that there was some important major new work, even whole new sciences, such as spherical geometry, and significant improvements to the old sciences. For example, consider the use of "zero." The Hindus had the concept of zero, but it was the Muslims who developed its use as a placeholder and, thus, made possible the powerful digital system upon which modern civilization is built. This computer in front of me has a memory filled with nothing but zeroes and ones. Were there no zero, its memory would consist only of ones and would be utterly useless. There are a few scholars who believe that what happened during the Islamic era was not just an increase in the sciences, however dynamic: it was, rather, a qualitative change in the way sciences were done, initiating or even completing the process of moving from the ancient way of doing science to the modern way of doing science. I have said that this was an epistemological transformation, going from a pure rationalism, as I defined the term, into a complex epistemology in which reason, observation and experiment, and authority play an interactive role, each one checking on the other.

Before I go into the details of how this was done, I want to justify my statement by pointing to the work of al-Ghazzali. Al-Ghazzali is a key figure. There are many who try to blame him for the downfall of the classical Islamic civilization, and there are others who think that he is the example *par excellence* of an important Islamic thinker. To me the important thing about al-Ghazzali is what he said about epistemology. It is important to consider how much of his view of the theory of knowledge in general matches the modern scientific approach to knowledge of the natural sciences. To understand al-Ghazzali, one must first understand that in the Islamic civilization there was an important school of scholars deeply impressed by the Greek philosophers. In fact, they were themselves called "the philosophers," the *falâsifa*. They were so heavily influenced by the Greeks that some scholars have tried to claim that they fell outside the mainstream of Islam, which is not true. They represented one side of Islamic thought. They were rationalistic in their approach, not as much as the ancient Greeks, for they were influenced by their own culture; but they did lean toward a worldview that came out of ancient Greece and conflicted with the Islamic view—not in the sciences, but in philosophy. For example, they believed that matter is eternal, not an Islamic concept. They thought the physical universe has always been here, always will be here, and has never changed in any fundamental way. Al-Ghazzali criticized this viewpoint. He attacked this view fundamentally, on epistemological grounds. He said that one could not learn about the reality of the universe by reason alone. He insisted that one also needs experience and the transmission of information from reliable sources.

Modern philosophers understand that logic is nothing more than a means of manipulating symbols. There can be no meaning assigned to the symbols by logic. The only reason a person can make meaningful statements about the world using logic is that experience allows the association of meanings with the symbols. If one looks around, one discovers that much is known that is not reasoned from first principles. There are things one can know only by transmission. For example, I know that Thule, Greenland, exists. I do not know this by experience, for I have never been there, and I certainly could not derive its existence from first principles. No simple set of self-evident axioms will allow me to prove the existence of Thule, Greenland, by some complex but rigorous chain of reason. What has happened is that honest and sane people who have been there have told me of their experiences, and I have no reason to doubt them. In addition, maps by reliable mapmakers confirm their claims.

Similarly, one has to rely on reason as well as experience. Walking through the desert I may perceive a lake in front of me, but if the circumstances are those under which reason dictates that a mirage is possible, I am justified in doubting the evidence of my own eyes. Add to this the evidence of transmission from a reliable source—say, a map that shows there is no lake in this place. Then I may rely on that map to correct my erroneous sensory experience. When I become skilled at testing these three sources of knowledge against one another, then I know that I am getting close to the truth and I may rely upon it. This is the epistemology of al-Ghazzali, and its parallels can be seen with the methods of modern science.

Did this come about during the Islamic era, and if so, why? I wish to look at how Islam, in contrast with the Greek model, treats each of these elements. The Qur'an offers high praise for all three of these sources of knowledge. The Qur'an praises reason and repeatedly condemns the polytheists for their adherence to ideas that contradict their intellectual sense. At the same time it urges humankind to "look at God's signs in the heavens and in the earth." In contrast to Plato's view, for example, that the material world is a poor reflection of the true world of ideas, the Qur'an insists:

> Do they not look at the sky above them?—How We have made it and adorned it, and there are no flaws in it? (50:6)

> ...No want of proportion wilt thou see in the creation of [God] Most Gracious. So turn thy vision again: Seest thou any flaw? (67:3)

Unlike the Platonic and Neoplatonic disdain for the material world, the Qur'an says that the material world is as much as sign of God as the verses of the Qur'an. In fact, the same word (*ayat*) is used to mean both the verses of the Qur'an and the phenomena of the natural world. The implication is that if someone sees what appears to be a flaw in God's creation, he or she should go back and look again. The flaw is not in God's creation, but in either the theory or the observation. Creation is always in perfect accord with the natural laws by which God governs it.

Finally, the Qur'an speaks of the reliable sources, usually in terms of the prophets who have brought God's message to humankind. The development of the concept of care in the proper citation of sources seems to have taken place in Islamic scholarship. I do not find it earlier. The Islamic law is based not only on the Qur'an, but also on the practice of the Prophet Muhammad (peace be upon him). But what was the practice of the Prophet? In the early days of Islam, people would always say, "Prophet did this" or "Prophet said that." But how would it be known whether it was true or not? To avoid accepting unfounded rumors, Muslim scholars were confronted with the challenge of evaluating the reliability of these traditions, called *hadîth*. Early scholars, notably Imam Bukhari and Imam Muslim, compilers of the most highly respected collections of prophetic traditions, set out to develop a scientific means of historical analysis to determine the accuracy of these traditions. They invented a discipline of proper citation. They would demand to know every link in the chain of transmission from the Prophet's lips to their own ears. Then they would develop biographies of those transmitters to determine their reliability. Did they have good memories? Were they honest? Did contiguous links in the chains of transmission actually ever meet one another? This is the precedent for modern standards of citation. I cannot publish a scientific paper containing the assertion, "Einstein says such and such," unless I give the publication in which he said it, or else plainly and plausibly claim that he said it to me directly, for example, in an unpublished lecture or private communication. This is the modern scientific approach to the argument from authority.

Unlike the commands of the capricious gods of polytheism, God's commands are fixed and eternal, reflecting Divine Unity in the unity of creation. The universe's conformity to divine law is a sign of the Creator's Unity. That the universe conforms to some objective law is an assumption that scientists must necessarily make in attempting to do their work. I must acknowledge that today there is a school of thought that denies the existence of an ontological objective reality. For the purpose of creating scientific models, however, even positivists must postulate operational principles as if such principles correspond to some hypothetical real world. Even positivists act as though there is a rule-based reality, even if they do not believe in it.

There are two important differences between the way the modern scientist uses the scientific literature and the way in which the medieval scientist approached the ancient scientific texts, the "ancient wisdom." Above all, modern scientists approach the literature critically; they do not assume that it is beyond question. And secondly, they require proper citation.

The Qur'an says that the prophet Abraham (peace be upon him) came to the conclusion that there must be only one God by looking objectively at the motions of the planets:

> So also did We show Abraham the power and the laws of the heavens and the earth that he might (with understanding) have certitude.
>
> When the night covered him over he saw a star: he said: "this is my Lord." But when it set he said: "I love not those that set."
>
> When he saw the moon rising in splendor he said: "This is my Lord." But when the moon set he said: "Unless my Lord guide me I shall surely be among those who go astray."
>
> When he saw the sun rising in splendor he said: "This is my Lord; this is the greatest (of all)." But when the sun set he said: "O my people! I am (now) free from your (guilt) of giving partners to God.
>
> "For me I have set my face firmly and truly toward the One Who created the heavens and the earth, and never shall I give partners to God."
>
> (6:75-79)

The apparent motions of the stars and planets make a good place to look at the differences between the modern and ancient methods of analyzing the natural world. I start with the concept of precession. In watching a spinning top closely, anyone will notice not only that the top spins about its axis, but also that the axis itself moves in a slow circular motion. This circular motion of the axis is called precession. Like a top, the earth's axis precesses slowly and points at different places on the sky as the centuries pass. The North Pole of the earth's axis now points in the general vicinity of the North Star; but it is moving slowly away in a wide circle that will bring it back again to the North Star in about 26,000 years.

This apparent "wandering" of the place where the North Pole points was known to the ancient Greeks. Hipparchus, in compiling his catalog of the positions of the stars in 179 B.C.E., noticed how much the stellar positions had changed from the time of the Babylonians' star catalogs and gave a value for the rate of precession. Three centuries later, Ptolemy, considered to be the greatest astronomer of antiquity, knew that the stars were no longer in the same place in the sky as they had been in Hipparchus' day. Ptolemy knew about precession and realized that a new star atlas was needed. What Ptolemy claimed to have done is to measure anew the positions of the stars in Hipparchus' catalog; and he issued a new catalog with revised positions. In fact, he did not measure their positions at all. What I'm going to say now will seem shocking, for I am speaking about the greatest astronomer of the ancient world. What Ptolemy did so shocked the historian of science Robert Newton that, in his book, *The Crime of Claudius Ptolemy*, he labeled Ptolemy a criminal for what he did. I claim that Ptolemy was not a criminal, but that he was working in that ancient Greek rationalistic paradigm in which what he did was not a crime, but was the obvious thing to do.

The most one can hope to find in an American high school textbook is a statement along the lines of "The Arabs preserved the ancient science." It is as if Muslims had done the West a favor to serve as curators of their science until they could get back to developing it.

Ptolemy took Hipparchus' catalog and, using Hipparchus's rate of precession, he calculated mathematically the corrections necessary to update the catalog (putting in some additional stars, as well) and published it, saying he had observed the positions. Hipparchus' value for the rate of precession, however, was slightly off. Had Ptolemy actually observed the stars from Hipparchus' catalog, he would have seen that the value of precession was off and could have made a correction to it, giving the world an improved value for the rate of precession. He did not.

Then came the days of the Muslims. They too knew that the star positions had changed and that new catalogs were necessary. What did they do? They measured the positions of the stars, they found that they did not match the theory, they scratched their heads and asked, "What's going on here?" Not understanding that Ptolemy and the ancients did their science differently, they incorrectly concluded that the rate of precession had changed since Ptolemy's day. They thought that the rate of precession must not be constant, that it must vary. So, they invented a complex theory to account for the variation. Later, they found that the rate of precession *is* constant, and they dropped the earlier value inherited from the ancients and replaced it with a completely new one.

For the Muslims, obviously, this rule, "If you see any flaw, look again," was taken very seriously, while for Ptolemy there was no such rule at all. Either that, or Robert Newton is right and Ptolemy *was* a criminal, which I do not believe. Like Aristotle, Ptolemy believed that everything is the way it is because it *must* be that way and *can* be no other way.

Another example relates to the detailed motions of the planets in the model known as the Ptolemaic system. The essence of the Ptolemaic system is not just the belief that the earth is at the center of the universe, although that is an important element. In Ptolemy's system, an ingenious and complex system of cycles, epicycles, and offset centers of velocity account for the motions of the planets. The details need not be given here, but the point is that it was very complex. This system was criticized by the Muslims on a variety of grounds, the significance of which has not been fully appreciated by modern Westerners who are obsessed simply with the question of whether the sun or the earth is at the center of the planetary system. The Muslim objections have nothing to do with whether the sun or the earth is at the center. To make this clear, I shall concentrate on the orbit of the moon, because everyone agrees and always has agreed that the moon goes around the earth. In the 13th century, there was a great Muslim scholar named Nasir ad-Din at-Tusi, who was the director of the marvelous observatory at Maragha. The equipment at Maragha was so precise that it was unmatched in Europe until Tycho Brahe's famous observatory in the 16th century. At-Tusi was an excellent observer, as Tycho was. In addition, he was an innovative theoretician and a wonderful observatory director. The Maragha observatory was not just an observatory; it was scientific research institution with a library of 400,000 books. At-Tusi attracted scientists from around the world to work with him, even including a Chinese scientist. He devised a new theory to substitute for Ptolemy's. This new system replaced Ptolemy's complicated model with the ingenious devise of picturing the planets as rolling within a series of concentric cylinders (or spheres). This powerful mathematical model (which scientists will readily see is equivalent to a series of linked vectors) is not only easier to understand, but is easier to adapt to the actual observations, whatever they may be.

At-Tusi himself only sought to show that his model could account for the same motions as Ptolemy's, but his student Ibn ash-Shatir used at-Tusi's powerful model to try to resolve observational problems with Ptolemy's system. Most Westerners have not appreciated the degree to which Muslims were concerned with observational issues. They object that it wasn't until Johannes Kepler's day that the minute differences between planetary positions in Kepler's models and Ptolemy's could be discerned. They miss the whole point: a correct theory must account for all the observations of objects the sky, not just the planetary positions. In the 14th century, Ibn ash-Shatir realized that something was wrong with Ptolemy's theory of the moon. If the moon really moved in the big epicycle in Ptolemy's model, then it would move huge distances out and in, out and in from the earth. Every time it moved in closer to the earth, and it should appear huge—twice the size of what is observed. He used at-Tusi's powerful theory to account for the moon's size as well as its position. Hundreds of years later Copernicus published his theory of the moon moving in circles on circles. He mentioned at-Tusi, but he never mentioned Ibn ash-Shatir, even though the so-called Copernican system is just Ibn ash-Shatir's system with the order of the circles changed. Despite this overwhelming circumstantial evidence, some Westerners refuse to admit of a link. They protest that Copernicus could not read Arabic and Ibn ash-Shatir was never translated into Latin. They forget that Copernicus learned astronomy at the University of Padua. Even though he spoke no Arabic, others on the faculty there knew of the work of Ibn ash-Shatir and, it would be expected, would have mentioned it to the promising young student.

The same word (*ayat*) is used to mean both the verses of the Qur'an and the phenomena of the natural world. The implication is that if someone sees what appears to be a flaw in God's creation, he or she should go back and look again. The flaw is not in God's creation, but in either the theory or the observation.

This brings me to the question of why this process of change from ancient to modern methods in science, which was evolutionary in the Muslim world, was a "revolution" in Europe. Why did it cause such a crisis that, to this day, people say that there is a conflict between religion and science? Most people point to the dispute as to whether the earth or the sun is at the center of the universe. Although all the classical Muslim scholars thought that the earth was at the center of the universe, they discussed the possibility that the earth might move, and they never found it to a theologically threatening concept. Al-Biruni dealt with the matter in the eleventh century, and although his principle monograph on the matter is now lost, in another book he says that this question must be answered purely on grounds of physics. It is neither a question of theology nor astronomy. Why is it not a question of astronomy? Because in Ibn ash-Shatir's theory, if the positions of the earth and the sun are switched, it makes no difference to the astronomical observations, which are absolutely identical.

To Muslims it makes no difference whether the earth is at the center or the sun is at the center; while in Europe, to claim that the sun is at the center was branded heresy. But why should the Europeans care? The reason is that the Ptolemaic system had become married to a theological structure of the European church, a structure known as "The Great Chain of Being." The Great Chain of Being goes back to the influence of Platonic, or Neoplatonic, philosophy on Church theology. This philosophy held God to be infinitely removed from humankind; the connection between them is not direct, but through this Great Chain of Being. Everything in the Chain has its place. God the Father is at the top, and beneath Him God the Son, the Spirit and the angels, and the Church, the Pope, the archbishops and so on down to the parish priest and the ordinary person, and so on. A person might believe this theological concept without identifying it with Ptolemy's science; but by this time in history, the identification had been made and, thus, the new science challenged the theology. To say that the earth is just circling about in space was to remove it from its place in the sacred Chain. It was a provocative thing to say. If the earth's place can be questioned, could not the Church's place be questioned, as well?

Galileo's case was a unique problem of his culture, with its marriage of theology and physics, confronted by a tide of new scientific ideas from another culture with another religion, and the Church's view that this science and this religion must be kept out of Europe.

Galileo Galilei always tried to separate the theology from the science; but unfortunately for him, he had a predecessor who did not. Giordano Bruno was an avid student of Islamic science and philosophy. Bruno argued not only that Copernicus is right—the earth goes around the sun—but that there are many other planetary systems like ours. Infinite numbers of them in universes, all equally under the God, removing the Church completely from the cosmological system.Unsurprisingly, Bruno was driven from Italy. He went to England, and then Germany, and then was invited back to Italy, where was called up before the Inquisition. He was found guilty of heresy and burned at the stake. So when Galileo was pressed on the point of his support for Copernicus, he recalled what happened to Bruno and he recanted. Ask anyone who writes on the tension between religion and science—regardless of whether they call for a reconciliation between them or deny its possibility—and they will all point to "the Galileo affair" as the stereotypical example of the problem. But Galileo's case was a unique problem of his culture, with its marriage of theology and physics, confronted by a tide of new scientific ideas from another culture with another religion, and the Church's view that this science and this religion must be kept out of Europe. Such an overreaction had a negative effect on Western science.

This accident of history provoked a crisis in Western Europe and people were forced to take sides. The question of whether to side with the new science or with the old science somehow became whether to side with science or with religion. There were three different responses to the question, the same three that can still be heard to this day. First of all, there is what I call the "fundamentalist" reaction, to take a word out of its contemporary context; this reaction is to side with religion and against science. Then there is the secularist response: siding with science against religion. And thirdly, there's the reconciliatory response, which says, "Let's see if we can bring religion and science into some sort of agreement." This leads to the Catholic Renewal, the Protestant Reformation, and to all the discussions found today about reconciling religion and science. This last group believes there need not be a conflict, but that some effort is required to effect a reconciliation.

So far, I have spoken about the positive contributions of Islamic science that Western science has adopted; but there is one element of Islamic science which Western science has not adopted, and that is the spiritual dimension of scientific study. The mainstream Muslim scientists, including even the Greek-inspired *falâsafa*, insist that their science leads them to faith. Throughout history, I think that science and monotheism, as a rule, go side by side fighting against paganism and superstition. In the modern West, there is an exception, with some tension between spirituality and science. I think that it has been to the detriment of Western science that this spiritual attitude toward science was not accepted. My view is that the recovery of spirituality does not require accepting an outdated cosmology. In order to reconcile faith and science, if reconciliation is necessary, there is no need to return to the Great Chain of Being. On the contrary, the Qur'anic cosmology is precisely what is needed to have comfort both with modern science and with religious faith—at least faith in the one God. The idea is that the universe is an egalitarian universe with an infinite numbers of suns and planets—possibly even infinite systems of life. There may be life on other worlds. Why not? All equally under the one God.

I am not urging that modern physics be married to theology in the systematic way that the Church once did—and that some try to do today. Instead, the understanding of physics should be added to the lexicon of symbols that aid in understanding the Divine Power. This is not something new, neither within nor outside of Islamic thought. Isaac Newton is blamed for being the initiator of the mechanistic, materialistic view of science so prominent in the West. It is said that he conceived of a "clockwork universe" that, even if created by the Divine Hand, no longer required God for its operation. Here is what Isaac Newton wrote in the closing of his magnum opus, *Principia Mathematica*:

> This most beautiful system of the sun, planets, and comets, could only proceed from the counsel and dominion of an intelligent and powerful Being. And if the fixed stars are the centers of other like systems, these, being formed by the like wise counsel, must all be subject to the dominion of One....[1]
>
> This Being governs all things, not as the soul of the world, but as Lord over all; and on account of his dominion he is wont to be called Lord God...and Deity is dominion of God not over his own body, as those who fancy God to be the soul of the world, but over servants. The Supreme God is a Being eternal, infinite, absolutely perfect.... He is eternal and infinite, omnipotent and omniscient; that is his duration reaches from eternity to eternity; his presence from infinity to infinity; he governs all things, and knows all things that are or can be done.... We adore him as his servants....[2]

To the Muslim hearing these words, Newton sounds as if he were paraphrasing the Qur'an. There is no evidence that Newton ever read the Qur'an, but he did read the Book of

Nature, God's other book; and so no one should be surprised that these are the conclusions he draws. I think that what is needed today is to engage in more critical thinking, to eschew blind imitation. Critical thinking, I believe, is the road not simply to reconciling faith and science, but to eliminating the myth that there should be in any conflict or tension between them.

I say the words I have said, and I ask for God's forgiveness.

Works cited:

Ahmad, Imad-ad-Dean. *Signs in the Heavens: A Muslim Astronomer's Perspective on Religion and Science.* Beltsville, Md.: Writers Inc., Intl., 1992.

Newton, Sir Isaac. *Mathematical Principles of Natural Philosophy.* In *Britannica Great Books,* vol. 34, ed. by Andrew Motte and Florian Cajori. Chicago: Encyclopedia Brittanica, 1934.

Newton, Robert. *The Crime of Claudius Ptolemy.* Baltimore: Johns Hopkins University Press, 1977.

Qur'an, The Holy. Trans. and commentary, Abdullah Yusuf Ali. Elmhurst, N.Y.: Tahrike Tarsile Qur'an, Inc., 1987.

Endnotes:

1. Isaac Newton, p. 369.
2. Ibid., p. 370.

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And the Robot Asked "What do you say I am?" Can Artificial Intelligence Help Theologians and Scientists Understand Free Moral Agency?

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Concepts of human beings as free and morally responsible agents are shared culturally by scientists and Christian theologians. Accomplishments of the "artificial intelligence" (AI) branch of computer science now suggest the possibility of an advanced robot mimicking behaviors associated with free and morally responsible agency. The author analyzes some specific features theology has expected of such agency, inquiring whether appropriate AI resources are available for incorporating the features in robots. Waiving questions of whether such extraordinary robots will *be constructed, the analysis indicates that they* could *be, furnishing useful new scientific resources for understanding moral agency.*

Introduction

Implications of contemporary scientific research have begun to provoke anxious questions among theologians and scientists regarding basic notions of ourselves as free and morally responsible agents. Representing Christian philosophy, for example, Nancey Murphy voices concern that "if mental events can be reduced to brain events, and the brain events are governed by the laws of neurology (and ultimately by the laws of physics), then in what sense can we say that humans have free will?"[1] In the same volume, Malcolm Jeeves amplifies Murphy's concerns by posing similar questions from a complementary scientific perspective:

> Since it would seem that everything that happens at the level of mind is tightly coupled with what is happening in a physical system, the human brain, what about notions of human freedom and responsibility?[2]

Although the foregoing questions are well motivated, they do not mention an important contemporary science and technology that should also be receiving attention. In particular, the subset of computer science known generally as "artificial intelligence" (AI) is now rapidly acquiring the hardware capabilities it needs to begin mimicking intelligent human behavior at seriously convincing levels. The following remarks from recent issues of popular news magazines serve to illustrate corresponding expectations within the AI community:

> AI prophet Ray Kurzweil, the Massachusetts-based inventor of pattern-recognition technology, says that computers will exceed human intelligence no later than 2020.[3]

> Could a robot ever really want anything? The hard-core reductionists among us, myself included, think that in principle this must be possible. [...] [T]here has been a renaissance of interest in robots that walk like humans, talk like humans, detect human faces and have the beginnings of human social responses. [...] [T]he direction is clear: robots are becoming more humanlike. Barring a complete failure of the mechanistic view of life, these endeavors will eventually lead to robots to which we will want to extend the same inalienable rights that humans enjoy.[4]

Some initial critical comments about statements of this sort seem appropriate. Experience with the real business of computer application software development readily teaches one to view all claims regarding capabilities of future systems with caution. More skeptical voices can also be heard outside the AI community. Regarding "computers or computer-controlled robots," for example, physicist Roger Penrose argues, "they deserve no share of the blame when things go wrong—that would always lie elsewhere!"[5] Speaking for both physics and theology, John Polkinghorne assures us "we know, as surely as we know anything, that we are not ourselves automata."[6] On the other hand, a few factual and representative AI accomplishments probably also ought to be acknowledged at this point. In 1995, a robotic system drove a Plymouth minivan from Washington, D.C., to San Diego, California, "in control 98.2% of the time, at an average speed of over 100 km/h."[7] In 1997, an AI chess playing system (Deep Blue) "beat world chess champion Gary Kasparov."[8] Honda Motors of Japan has produced a humanlike robot with "fully functional arms and camera eyes" that is capable of "walking, on flat and sloped ground, and up and down stairs."[9] In balance, something like the following modest judgment seems intellectually fair at this time: AI science and technology appear to have matured sufficiently to be considered in the kinds of discussions of free and morally responsible agency we have initially illustrated with the comments by Nancey Murphy and Malcolm Jeeves. It should be reasonable to begin investigating the possible use of artificially intelligent systems as laboratories for exploring traditional understandings of humanity.

In this essay, I furnish a limited investigation of this type, viewing notions of free and morally responsible agency against a background of AI science and technology. As accounts of some traditional concepts of human freedom and moral responsibility are assembled, associated features will be compared with AI resources now available. To facilitate and focus such comparisons, the hypothetical construct of an advanced robot (named "Andrew") will be assumed. Typical use of this construct will propose specific AI resources that could be incorporated into Andrew to realize identified features of moral agency. In all cases, the objective will be restricted to specifying AI resources that plausibly could permit the robot to exhibit selected features of moral agency. Explicit design proposals, as well as response to the related question of whether a robot of this type actually will be constructed, are not among the responsibilities I have assumed in this essay.

Two additional observations may help define the scope of this analysis. First, the kinds of free and morally responsible agents most often considered in theological discussions are, understandably, human beings and God. Paul Tillich, in his *Systematic Theology*, suggests "freedom and destiny can be applied to subhuman nature only by way of analogy."[10] Although I shall broadly be sharing Tillich's notion of "analogy," exploring principally the analogy of human freedom for the particular "subhuman" case of a robot, it will also become evident that considering the special case of God's free agency cannot be avoided in an investigation of this type. Secondly, all features of human freedom and moral responsibility investigated here are to be understood as operating at the agent level of description. I shall not, for example, be ascribing free will to individual neurons of the human brain or to individual circuit elements of a robot. This is a convention with ample support from the theological community—as theologian Jonathan Edwards concisely observed, "the will itself is not an agent that has a will."[11]

Analysis

Convenient labels for several features most regularly ascribed to morally responsible agents in theological and related works are the following:

- reason
- community
- awareness
- free will

Although this list is not exhaustive and its simple labels will require some explanatory expansion, it provides a useful outline for the topics to be addressed.

Reason

Defined even in the minimal sense of comprising a normal capability for logically correct ratiocination, reason has a long history of being regarded as at least a necessary feature of any agent to whom we might properly ascribe moral responsibility. In the thought of Saint Thomas Aquinas, the "practical reason," recognizing "the good as the end of human conduct," allows us to infer, as a guide to moral choices of action, "good is to be done and pursued."[12] Implicit in prescriptions of this sort has been an additional assumption the rational agent can recognize cases permitting application of moral principles—an assumption reflected in modern criminal law with the so-called "M'Naghten rules," according to which "a person has a defense of insanity if he did not know the nature and quality of the act he was doing, or did not know that it was wrong, because laboring under a defect of reason from disease of the mind."[13] Traditionally, then, both morally and legally responsible agents have been expected to display a capability to recognize cases requiring moral choice and to make reasoned judgments about those choices, relative to some moral standards.

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Neither of the foregoing requirements appears to present a technical challenge, in principle, that should prevent our hypothetical robot, Andrew, from achieving this much of the status of a morally responsible agent. Rule-based reasoning has been a staple of AI technology for years, and statements of the form "good is to be done and pursued" are not unlike the global assertions knowledge engineers typically elicit from "domain experts" in the course of their "knowledge acquisition" work. Although the levels of abstraction found in words such as "good" undeniably could pose some difficulties for knowledge representation in our robot, the more serious practical difficulties in design and development would be likely to involve the task of equipping Andrew to recognize situations requiring moral choices. Again, however, there is an established AI technology—case-based reasoning—that offers resources appropriate for responding to the functional requirement. To the extent morally responsible agents have traditionally been expected to exhibit the features of reason that have been characterized, specific existing AI resources appear sufficient for satisfying, in a robot, at least this much of the requirement.

Community

Even when it is understood as nothing more than a social group of interacting agents sharing certain common characteristics, community can be recognized as a logically necessary context for any meaningful discussion of morally responsible behavior. Moreover, any agent expected to display responsible behavior within a community must possess at least some set of elementary capabilities for relevant kinds of social interaction. Theologian H. Richard Niebuhr, in *The Responsible Self*, identifies several capabilities presumed by the "idea or pattern of responsibility."[14] Functionally, any agent satisfying Niebuhr's analysis must somehow be able to recognize itself as an agent in community, interpret and respond to actions by other agents, and formulate expectations concerning the responsive behavior of other agents. A broadly similar insight is expressed by theologian Paul Tillich in *Morality and Beyond*:

> The moral imperative is the command to become what one potentially is, a person within a community of persons."[15]

Accordingly, the community feature of morally responsible agency—as it has been viewed among theologians—would at least challenge our hypothetical robot, Andrew, to incorporate some representation of himself as an agent liable to certain kinds of interactions with other agents.

Substantial AI resources for such incorporation already exist. "Distributed artificial intelligence" (DAI) is an area characterized by Nicholas Avouris and Les Gasser as going "beyond the study of individual 'intelligent agents' solving individual problems, to consider problem solving that has social components."[16] A specific example of such research is work led by Professor Barbara Grosz, at Harvard, on "Collaborative Planning and Human-Computer Communication"; the work is described on its website as "developing intelligent computer 'agents' that work together in teams."[17] One element of DAI research that responds most clearly to the challenges facing our hypothetical robot is known as "agent modeling." Development of communities of interacting artificially intelligent agents has revealed the functional advantage of equipping the agents with dynamic internal representations of themselves and other agents—i.e., with "agent models." As Avouris and Gasser point out, one benefit of this technique is that it "allows an agent to predict the behavior of other agents"[18]—a capability bearing remarkable resemblance to the previously mentioned observations by H. Richard Niebuhr, which require a responsible agent to have "expectation of response to his response."[19] Indeed, it could well be the case that elements of Niebuhr's analysis should prove useful in AI work of the sort being conducted by Professor Grosz. In any event, there appear to be sufficiently clear parallels between theological and AI notions about the community feature of responsible agents to make incorporation of this feature into Andrew a plausibly realistic objective.

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Awareness

Also known as "self" awareness, and understood as the passive aspect of normal human consciousness, awareness presents a regularly assumed feature of morally responsible agency that is qualitatively different from those already considered. John Polkinghorne has displayed appreciation of this point, observing that "in self-consciousness we are getting close to the centre of the mystery of personhood."[20] Although legal responsibility is strictly not identical with moral responsibility, a compatible view may be found in comments by Hyman Gross concerning legal grounds for excuse from criminal liability. Specifically, Gross takes these grounds to include "separation of consciousness and action such as exists during hypnosis, somnambulism, and epileptic seizures."[21] I have already identified AI resources that might plausibly be applied to furnish the reason and community features required of a morally responsible agent. Now come challenges from theology and law to equip this hypothetical robot also with awareness—certainly not the kind of functional requirement normally encountered in the business of computer systems engineering! How might a practitioner of AI science and technology respond to this challenge?

One helpful clue toward an answer was suggested years ago by AI pioneer John McCarthy; his general prescription is elegantly concise:

> To ascribe certain 'beliefs', 'knowledge', 'free will', 'intentions', 'consciousness', 'abilities', or 'wants' to a machine or computer program is legitimate when such an ascription expresses the same information about the machine that it expresses about a person.[22]

Following McCarthy's advice, one is led to ask exactly what can ever be known about a person that one might attempt to express regarding that person's consciousness. Considered rigorously as a question about direct knowledge of the other person's subjective experience, it should seem that the honest answer is "nothing." But surely, one might object, an experienced neurologist—having worked for years with patients showing numerous types of neurological disorders specifically affecting consciousness—would be more brave about drawing inferences from behavior regarding a patient's awareness! Alas, Antonio Damasio, a neurologist with just such credentials, says:

> The idea that the nature of subjective experiences can be grasped effectively by the study of their behavioral correlates is wrong.[23]

Damasio is doubly relevant to the topic at hand, for he has also offered explicit opinions, in *The Feeling of What Happens*, on the question of consciousness in artifacts of the kind under discussion. Although he believes "we have little chance of creating an artifact with anything that resembles human consciousness, conceptualized from an inner-sense perspective," Damasio acknowledges that "we can create artifacts with the formal mechanisms of consciousness proposed in this book, and it may be possible to say those artifacts have some kind of consciousness"—in fact, he recognizes that "external behaviors of artifacts with formal mechanisms of consciousness will mimic conscious behaviors and may pass a consciousness version of the Turing test."[24]

Although Damasio does not work professionally in the field of AI (and makes no claim of this kind), it is my opinion that many individuals with AI expertise could accept his conclusions. Much of the argument he develops in *The Feeling of What Happens* may broadly be described as directed toward showing that the human brain can form (physical) representations of the self (qua individual organism) as well as interactions of the self with an environment that includes other selves. To this extent, he describes a general task of representation that could, in principle, be served by types of AI resources we have already reviewed (e.g., case-based reasoning and DAI). His additional insistence that—in effect—no amount of behavioral evidence can prove the presence of awareness in an agent is essentially a philosophical position that the present author endorses (but cannot, in this limited venue, undertake defending). Applying the philosophic position to a question already posed, however, reveals an interesting result. Waiving possible arguments regarding telepathic phenomena, one strictly knows nothing about the awareness of persons or robots; hence, (returning to the language of John McCarthy's advice) the legitimacy of ascribing awareness to a machine—relative to information one actually can express about the machine—is no more dubious than the legitimacy of ascribing awareness to a person.

On the other hand, an important additional observation concerns the way people are actually likely to respond to robots exhibiting convincing mimicry of human behaviors that are normally taken to reflect the presence of awareness. This pragmatic point is illustrated in remarks by roboticist Hans Moravec, who argues—for "robots that are properly communicative"—most people will interpret the artifacts as possessing "thoughts and beliefs and feelings," quite regardless of "how they internally achieve the behavior."[25] How, then, might an AI practitioner respond to the challenge to equip Andrew with awareness? The answer recommended in the present discussion may be summarized in the following propositions:

• No behavioral evidence may be expected ever to prove (or disprove) Andrew has achieved awareness.

• Plausibly achievable ("humanlike") behavior may be expected to persuade many people to treat Andrew as an agent with awareness.

Free will

"Free will" is probably the one expression most commonly associated with the notion of a morally responsible agent, and writers in the Christian theological tradition consistently recognize it as a feature of human agents that uniquely links them to God. Jonathan Edwards, for example, describes human free "capacity of choice" with the comment, "herein does very much consist that *image of God* wherein he made man." [26] Similarly, theologian Daniel Migliore notes that modern interpreters "have emphasized human freedom as the meaning of the image of God." [27] Free will, as a feature of morally responsible human agency, has clearly been assigned a status of singular importance in Christian theology.

The prospects of incorporating free will in an advanced robot such as Andrew appear to be a function of how "free will" is defined—and, on this point, the religious community displays some divergence. A concept that regularly generates the differences is the notion of determinism. Elements of this notion, in turn, characteristically include requirements—as suggested by Gerald Dworkin—that a determined event be "causally necessitated," have a "sufficient explanation in causal terms" and be "in principle predictable." [28] Applying this concept to agents who are claimed to be exercising "free will" as they make moral choices, two different definitions of the agent's freedom have historically been distinguished by their treatment of determinism. First, following the common terminology used by Malcolm Jeeves, a "compatibilist" definition of freedom may be identified (endorsing so-called "liberty of spontaneity") as any definition that is compatible with the agent's moral choices being subject to determinism.[29] Secondly, a contrasting definition of freedom—associated with the expressions "liberty of indifference" and "libertarian view of freedom"—is represented in any definition that is not compatible with the agent's moral choices being subject to determinism.[30] One can recognize the outlines of two very different kinds of challenge being placed by these contrasting definitions of "free will" against the resources of AI science and technology. I shall now examine them in succession, beginning with the compatibilist position.

Representing the substantial theological tradition known as Calvinism, Jonathan Edwards furnishes particularly clear illustrations of compatibilist views. The following comment from Edwards' *Freedom of the Will* is a concise expression of his basic position:

> Let the person come by his volition or choice how he will, yet, if he is able, and there is nothing in the way to hinder his pursuing and executing his will, the man is fully and perfectly free, according to the primary and common notion of freedom.[31]

Indeed, modern scientific understanding of the human brain was essentially unavailable to Edwards; nevertheless, it may be reasonably inferred that he should not have been likely to share the worries Nancey Murphy was initially found to express—concerning potential reduction of "mental events" to "brain events"—even if the pertinent scientific information had been supplied.

Turning now to the corresponding challenge of identifying resources of AI science and technology that might be incorporated in Andrew to give this hypothetical robot a compatibilist version of free will, what one discovers is rather surprising. Relieved of all concern about determinism, AI engineers should be free to employ any appropriate technique—such as rule-based reasoning, artificial neural networks, or case-based reasoning—that would plausibly contribute to Andrew's capabilities for "humanlike" moral choice behavior. In fact, the compatibilist position just might pose a more serious problem for theology than it does for AI. Would Jonathan Edwards, for example, really still be comfortable asserting, "Let the robot come by his volition or choice how he will, yet, if he is able, and there is nothing in the way to hinder his pursuing and executing his will, the robot is fully and perfectly free!"

Not everyone, of course, has been satisfied with the compatibilist position. Jonathan Edwards was quite aware of this, arguing against "Arminians, Pelagians and others [who] oppose the Calvinists [and view human liberty] as opposed to all necessity, or any fixed and certain connection with some previous ground or reason."[32] Extreme versions of this alternative view—as Alasdair MacIntyre has pointed out, for the case of Søren Kierkegaard—may be subject to internal logical problems; given the "Kierkegaardian concept of choice" as "criterionless," it is difficult to explain how "one choice can be more correct than another."[33] Indeed, if one is already uncomfortable about ascribing free will to the computer-based reasoning of a robot, being told, "That's OK—we'll design Andrew to roll dice when he faces any moral decision," should hardly be enough to make the robot seem morally responsible. On the other hand, it has been argued by philosopher J. J. C. Smart that the strategy of seeking an account of free will rejecting both determinism and randomness may be likened to defining "a new sort of natural number, a 'free' number, as one which is neither prime nor divisible by a number which is greater than one and smaller than itself."[34] The direction of Smart's argument has critical implications for the current topic. If it is the case that free will must be either deterministic or random, and neither disjunctive choice allows meaningful moral responsibility, then neither theologians nor AI engineers can have a coherent concept of morally responsible agent with free will to engage. I suggest that this is not the case, and feel obliged to propose a "better way" to interpret the issues in dispute.

Opponents of the compatibilist position—as Smart also acknowledges—need not all be accused of offering the absurd alternative claim "we are responsible for those of our actions which are due to pure chance."[35] Instead, what one typically finds in their arguments is rejection of particular types of determinism, some examples of which may be described in the following manner: (1) determinism that is reductive, (2) determinism that is blind to the distinction between possibility and actuality, and (3) determinism that insists on total predictability. Although they would disagree with a general assertion that determinism is compatible with free will, these critics are more precisely described as disagreeing with assertions that certain types of determinism are compatible with free will. I shall now examine, in succession, each of these cases.

Opponents of reductive determinism tend not to dispute scientific accounts of lawful bodily operations, such as neural activity, but rather to resist "reductionist" explanations of the choices we make as persons. Nancey Murphy, for example, has argued at length against "causal reductionism," ending with the conjecture that "a positive account of how free will is embodied in neurological functioning" should come from "appreciating the multiple interacting layers of information processing in the brain."[36] Similarly, John Polkinghorne develops the notion of a "downward causation," of the kind involved "when we will the movement of our arm," insisting "every level of description may impose its own organizing pattern upon the flexibility of what can occur."[37] These illustrative comments reflect a basic awareness that we examine and understand our world at different so-called "levels of description." Implications of this insight tend to embarrass reductive enterprises such as attempts to explain personal moral choices exclusively in terms of the laws of physics, encouraging multilevel interpretations of complex systems.

Multilevel thinking "comes naturally" in the domain of computer science. We find computer science professor Douglas Hofstadter, for example, expressing thoughts remarkably like those of Nancey Murphy, John Polkinghorne and their colleagues:

> My belief is that the explanations of "emergent" phenomena in our brains—for instance, ideas, hopes, images, analogies, and finally consciousness and free will—are based on a kind of Strange Loop, an interaction between levels in which the top level reaches back down towards the bottom level and influences it, while at the same time being itself determined by the bottom level.[38]

Being card-carrying members of the computer science community, AI engineers and roboticists should be no less disposed than Hofstadter to recognize what he describes as "causes that propagate both upwards and downwards" in multilevel systems.[39] Accordingly, they should be comfortable defending our hypothetical robot, Andrew, with ideas now found both in computer science and theology. Critics of Andrew might complain, "This robot has no free will—his moral choices are determined merely by the physical operation of his circuitry." Andrew's designers should be expected to reply, "His moral choices are emerging through interactions of high-level software representations of his moral principles and low-level sensor inputs revealing his situation. All of this certainly does happen to get realized in the operation of his circuitry, but that's not what is under discussion here—an exhaustive account of all the electronic activity in Andrew does not tell us what he is doing." (In fairness, it seems, the robot should deserve at least as much defense against "causal reductionism" as his human counterparts.)

The foregoing reference to a type of determinism that is "blind to the distinction between possibility and actuality" is a nonstandard labeling that warrants some preliminary explanation. The explanation, in turn, begins with some brief comments regarding theoretical physics. So-called "Laplacian determinism" has rather been a benchmark concept of determinism since it was enunciated by eighteenth-century mathematician Pierre Simon de Laplace. It is a determinism correspondingly innocent of the twentieth-century revelation, from quantum theory, that it is impossible to obtain the information about simultaneous positions and momenta required to describe a "clockwork universe" in which successive states of macroscopic physical systems are precisely defined and predicted. Although at least one respected scientist accordingly identifies quantum mechanics as "the graveyard of determinism,"[40] it does not immediately follow that all manner of determinism has vanished from physics. A first note of caution in this regard is sounded by Roger Penrose, in *Shadows of the Mind*, with this observation:

> It is *not* Cardano's *probability* theory that operates at the quantum level, despite the common opinion that the quantum world is a probabilistic world. Instead, it is his mysterious theory of *complex numbers* that underlies a mathematically precise and *probability-free* description of the quantum level of activity.[41]

Penrose proceeds to explain that, although superpositions of states may be alien to everyday experience, the (Schrödinger) equations describing evolution of this strange "micro-world" yield a "description that is indeed mathematically precise and, moreover, completely deterministic!"[42] Recognizing that some scientists[43] hold an interpretation of quantum theory under which the Schrödinger equations describe a world of (superimposed) possibilities (with quantum measurement revealing the world of actualities), the determinism mentioned by Penrose may be identified as a determinism that is sensitive to the distinction between possibility and actuality. In contrast, it is specifically Laplacian determinism that is "blind" to this discrimination. The distinction between possibility and actuality appears also to be a feature of process theology. Whatever its exact relation to quantum physics, process theology clearly is not consistent with Laplacian determinism and views free moral choices as a "wedge of novelty"[44] or a "creative advance into novelty"[45] that maps possibility into actuality.

A third type of determinism, insisting upon total predictability—that is, predictability for all cases—is also rejected by some as a determinism compatible with free will. John Polkinghorne draws attention—in *Science and Providence*—to macroscopic "complex dynamical systems" that display "a delicate sensitivity to circumstance which makes them intrinsically unpredictable," affording us "the prospect of describing a world in which we (and God) have freedom to act."[46] For the specific case of nonlinear dynamical systems, at least, Polkinghorne may be overstating uncertainties somewhat by claiming "The future is no longer contained in the past"[47]; mathematical equations describing systems of this kind do offer an in-principle determinism, although practical ignorance of their initial conditions typically makes the systems in practice unpredictable. Nevertheless, his recognition that authentic freedom calls for something less than a determinism yielding perfect predictability is clearly shared by computer scientist Douglas Hofstadter. Hofstadter reaches the conclusion, however, by a somewhat different path. He begins a thought experiment involving several kinds of systems (including a robot) with the suggestion, "By carefully groping for what we really mean when we choose to describe a system—mechanical or biological—as being capable of making 'choices,' I think we can shed much light on free will."[48] His thought experiment eventually progresses to the case of a chess-playing robot equipped with a limited ability to monitor the processes resulting in its own choices. Hofstadter then offers the following interesting observation about this case:

> [T]his program does monitor itself and does have ideas about its ideas—but it cannot monitor its own processes in complete detail, and therefore has a sort of intuitive sense of its workings, without full understanding. *From this balance between self-knowledge and self-ignorance comes the feeling of free will.*[49]

If one replaces Hofstadter's stipulation that the robot "cannot monitor its own processes in complete detail" with the notion that it finds its choices "in practice unpredictable," one discovers a striking resemblance between the insights of Hofstadter and Polkinghorne. The computer scientist's thought experiment adds an assertion, though, that seems somewhat more illuminating—from a "balance between self-knowledge and self-ignorance" comes our "feeling of free will." Indeed, if our own moral choices were found to be unpredictable in practice because their bases were altogether inscrutable, any claims of moral responsibility should be difficult to maintain.

If an AI engineer were called upon to design an advanced robot incorporating the two requirements of free will just described—that is, a free will consistent with moral choices we feel are mapping us from possibilities into actualities, through processes we only partly understand—which available AI resources might be prescribed? Fuzzy logic technology should be expected to figure prominently in the answer, for it satisfies both requirements. Systems using fuzzy logic typically combine rules in symbolic form (e.g., "If charity's need is great and my resources are ample, then my contribution should be large") with more opaque computations (e.g., determination of centroids during defuzzification). In this sense, fuzzy logic systems inherently furnish support for modeling the "balance between self-knowledge and self-ignorance" prescribed by Hofstadter. Fuzzy logic sys-

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tems also are structurally suitable for modeling mappings of possibilities into actuality. It is a distinguishing property of fuzzy logic inference systems that multiple rules can contribute to each inference (unlike bivalent logic systems, in which only one rule is selected for "firing"). This means that contradictory conditions can be considered during computation of each conclusion—a property inherently suited for modeling realms of possibilities, as well as the paradoxical superpositions found in quantum mechanics. It should be acknowledged that a potential objection to the use of large fuzzy logic systems—of the sort we should expect in an advanced robot such as Andrew—is the enormous size of the rule sets they could entail. Modular design of the rule sets can substantially relieve this problem,[50] although it could remain a limitation of some importance on implementation scale.

Conclusion

The foregoing analysis of free and morally responsible agency, as it has been understood in theological communities and others closely related, addressed four fundamental features of the concept—reason, community, awareness and free will. In each case, comparison of these features with available AI resources revealed no obstacles, in principle, to their future incorporation in an advanced robot (although some possible scale limitations upon fuzzy logic inference systems were acknowledged). Traditional accounts of the examined features, therefore, appear generally to be translatable into elements of AI science and technology.

Jesus repeatedly asked his disciples "Who do you say I am?" (e.g., Mark 8:29). Results from this essay are an invitation to envision the robot Andrew asking a different but similar kind of question: "What do you say I am?" Would human beings comfortably answer that Andrew is a free and morally responsible agent if he can convincingly pass a special version of the Turing test—one specifically tailored to include behavioral criteria based on the foregoing analysis? If he is denied this status, how might this response be explained? In either case, artificial intelligence already furnishes the technical vocabulary and laboratory resources identified in this essay for expressing and experimentally supporting the answers given. Moreover, it can be reasonably expected that work with AI methods should occasionally illumine traditional theological views—it is, after all, a venerable lesson of computer science that one very reliable way to understand something thoroughly is to try simulating it in software. In sum, there are good reasons to believe artificial intelligence can help theologians and scientists advance their understandings of free moral agency.

Works cited:

Brooks, Rodney. "Will Robots Rise Up and Demand Their Rights?" *Time* (19 Jun. 2000): 86.

Copleston, Frederick. *A History of Philosophy*. Vol. 2. Part II. Garden City: Image Books, 1962.

Damasio, Antonio R. *The Feeling of What Happens: Body and Emotion in the Making of Consciousness*. Orlando: Harcourt, Inc., 1999.

Dworkin, Gerald. "Introductory Essay." In *Determinism, Free Will, and Moral Responsibility*, ed. by Gerald Dworkin, 1-10. Englewood Cliffs: Prentice-Hall, 1970.

Edwards, Jonathan. *Freedom of the Will*. Ed. Arnold S. Kaufman and William K. Frankena. Indianapolis: The Bobbs-Merrill Company, 1969.

Gasser, Les. "An Overview of GAI." In *Distributed Artificial Intelligence: Theory and Praxis*, ed. by Nicholas M. Avouris and Les Gasser, 9-30. The Netherlands: Kluwer Academic Publishers, 1992.

Gross, Hyman. "Mental Abnormality as a Criminal Excuse." In *Philosophy of Law*, ed. by Joel Feinberg and Hyman Gross, 2nd ed., 482-90. Belmont: Wadsworth Publishing Company.

Grosz, Barbara J. "Artificial Intelligence: Collaborative Planning and Human-Computer Communication." Internet document from the website of Barbara Grosz: <http://www.eecs.harvard.edu/grosz/>

Heineken, Carolyn, Theodore Metzler, Rafael Ortiz, and Ray Wonsewitz. "Tuning a Fuzzy Expert System for Simulations of Population Behavior." In *Proceedings of the IASTED International Conference on Modelling and Simulation*, 317-321. Anaheim: ACTA Press, May 1999.

Hofstadter, Douglas R. *Gödel, Escher, Bach: An Eternal Golden Braid.* New York: Vintage Books, 1979.

Jeeves, Malcolm. "Brain, Mind, and Behavior." In *Whatever Happened to the Soul? Scientific and Theological Portraits of Human Nature*, ed. by Warren S. Brown, Nancey Murphy, and H. Newton Malony, 73-98. Minneapolis: Fortress Press, 1998.

MacIntyre, Alasdair. "Kierkegaard, Søren Aabye." In *The Encyclopedia of Philosophy*, ed. by Paul Edwards, vol. 4, 336-40. New York: Macmillan Publishing Co. & The Free Press, 1967.

McCarthy, John. "Ascribing Mental Qualities to Machines." In *Philosophical Perspectives in Artificial Intelligence*, ed. by Martin D. Ringle, 11-12. Atlantic Highlands: Humanities Press.

McKenna Hamilton, Carol, and Sara Hedberg. "Modern Masters of an Ancient Game." *AI Magazine* (Winter 1997): 11-12.

Metzler, Theodore, and Rafael Ortiz. "Modeling Population Behavior with Fuzzy Logic Agents." In *Smart Engineering Systems: Neural Networks, Fuzzy Logic, Data Mining, and Evolutionary Programming*, vol. 7, ed. by Cihan H. Dagli, Metin Akay, Okan Ersoy, Benito Fernandez, Alice Smith, 273-78. New York: ASME Press, 1997.

Migliore, Daniel L. *Faith Seeking Understanding: An Introduction to Christian Theology*. Grand Rapids: William B. Eerdmans, 1991.

Moravec, Hans. *Robot: Mere Machine to Transcendent Mind.* New York: Oxford University Press, 1999.

Murphy, Nancey. "Nonreductive Physicalism: Philosophical Issues." In *Whatever Happened to the Soul? Scientific and Theological Portraits of Human Nature*, ed. by Warren S. Brown, Nancey Murphy, and H. Newton Malony, 127-48. Minneapolis: Fortress Press, 1998.

Niebuhr, H. Richard. *The Responsible Self: An Essay in Christian Moral Philosophy.* New York: Harper, 1963.

Penrose, Roger. *Shadows of the Mind: A Search for the Missing Science of Consciousness.* New York: Oxford University Press, 1994.

Polkinghorne, John. *Science and Providence: God's Interaction with the World.* Boston: Shambhala, 1989.

_____. *The Faith of a Physicist: Reflections of a Bottom-Up Thinker.* Minneapolis: Fortress Press, 1994.

Schroeder, Gerald L. *The Science of God: The Convergence of Scientific and Biblical Wisdom.* New York: Broadway Books, 1997.

Smart, J. J. C. "Free Will, Praise and Blame." In *Determinism, Free Will, and Moral Responsibility*, ed. by Gerald Dworkin, 196-213. Englewood Cliffs: Prentice-Hall, 1970.

Suchocki, Marjorie Hewitt. *God, Christ, Church: A Practical Guide to Process Theology.* New York: The Crossroad Publishing Company, 1989.

Tillich, Paul. *Morality and Beyond.* Louisville: Westminster John Knox Press, 1963.

_____. *Systematic Theology.* Vol. I. Chicago: University of Chicago Press, 1951.

Tolson, Jay. "Who=am I^2: Introspective scientists are probing the mystery of human consciousness." *U.S. News & World Report* 128 (12 June 2000): 50-51.

Whitehead, Alfred North. *Process and Reality: An Essay in Cosmology.* New York: The Free Press, 1957.

Endnotes:

1. Murphy, p 131.
2. Jeeves, p. 75.
3. Tolson, p. 51.
4. Brooks, p. 86.
5. Penrose, p. 36.
6. Polkinghorne, *Science and Providence*, p. 1.
7. Moravec, p. 45.
8. McKenna Hamilton, p. 11.
9. Moravec, p. 99.
10. Tillich, *Systematic Theology*, p. 185.
11. Edwards, p. 32.
12. Copleston, pp. 126-127.
13. Gross, p. 483.
14. Neibuhr, p. 65.
15. Tillich, *Morality and Beyond*, p. 19.
16. Avouris and Gasser, p. 9.
17. Grosz.
18. Avouris and Gasser, p. 15.
19. Neibuhr, p. 65.
20. Polkinghorne, *The Faith of a Physicist*, p. 11.
21. Gross, p. 482.
22. McCarthy, p. 161.
23. Damasio, p. 309.
24. Ibid., p. 314.
25. Moravec, p. 83.
26. Edwards, p. 35; emphasis added.
27. Migliore, p. 122.
28. Dworkin, p. 4.
29. Jeeves, p. 95.
30. Ibid.
31. Edwards, p. 33.
32. Ibid., pp. 33-34.
33. MacIntyre, pp. 337, 339.
34. Smart, p. 197.
35. Ibid., p. 199.
36. Murphy, p. 139.
37. Polkinghorne, *Science and Providence*, p. 29.
38. Hofstadter, p. 709.
39. Ibid.
40. Schroeder, p. 33.
41. Penrose, p. 258.
42. Ibid., pp. 258-59.
43. E.g., see Schroeder, p. 148.
44. Suchocki, p. 17.
45. Whitehead, p. 200.
46. Polkinghorne, op. cit., p. 2.
47. Ibid.
48. Hofstadter, p. 711.
49. Ibid., p. 713, emphasis added.
50. See Heineken, et al.; Metzler and Ortiz.

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Author's note: *I wish to thank the Reverend Linda Pope for recommending that I see the movie* Bicentennial Man. *The movie helped motivate me to write this essay, and its contribution is reflected in the name I borrowed for the hypothetical robot.*

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Constructing Futures: Outlining a Transhumanist Vision of the Future and the Challenge to Christian Theology of its Proposed Uses of New and Future Developments in Technology

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Transhumanists are committed to re-evaluating the entire human condition and offering proposals for transcending mortality, principally by augmenting the human body with mechanical components or by transferring the human mind into intelligent hyper-computers. In this essay, the author's methodology is to critique the culture of transhumanism, arguing, with Barbour, that all technology is tool whose use is determined by the cultural and social frameworks within which it is utilized. Transhumanism is characterized as morally ambiguous, extremely individualistic, fixated upon health, vitality, and power, ideological, reductionist, and self-deluded. Its proposed use of technology is, thus, highly suspect and deserves a robust theological response.

Introduction

I came across transhumanist writings when following a number of internet links in connection with the film, *The Matrix*, a futuristic film rich in philosophical and religious themes, in which the everyday world is perceived as real. Cinema-goers are made aware, however, that this world is, in fact, a deliberate deception, an electronic simulation. The reality is that human beings are kept in a state of suspended animation, their body heat generating sufficient electricity to run the all-powerful machines of artificial intelligence. It is a future in which evolution has seen the machine triumph over humans. It is a future in which machine intelligence has outwitted human intelligence. Deep Thought's great-grandchild is now the supreme Grand Master. *Requiescat in pace*, Kasparov!

In *The Matrix*, the moral ambiguity of humanity is certainly hinted at, but the dominant theme is unmistakably that of a world of brutal and total domination, directed with ruthless efficiency by intelligent machines. Transhumanism deserves some attention because Transhumanists are actively committed to turning aspects of this piece of celluloid fiction into electronically augmented fact.

What is transhumanism?

The internet home page of the World Transhumanist Association states the following:

> Transhumanism advocates the use of technology to overcome biological limitations and transform the human condition.[1]

Transhumanism seeks the acceleration of human life beyond its human form and limitations via science and technology. It is more than an abstract belief; it is an attempt to re-evaluate the entire human condition. The suggestion that mortality will one day be overcome through the application of science might appear at first to be a claim from the pages of a science fiction novel. Although transhumanist philosophers and scientists currently predict that this is likely to be a long-term project, they express boundless confidence that the eventual evolution of post-human species will relegate *Homo sapiens* to a mere staging post in the evolution of intelligence.

Transhumanists recognize that to arrive at a post-human[2] stage of evolution will require massive leaps in technology. Fortunately, there are a number of intermediate technological advances that they encourage as a means of extending the quality and length of human life in the meantime. Transhumanists, particularly those who belong to the branch known as Extropianism, are committed to living out their transhumanist philosophy. Life-enhancing drugs, gene therapy, the elimination of aging, the abolition of disease, and cryonic preparation of those already dead for possible future revivification, are all examples of technologies that Transhumanists believe will offer short- to medium-term advances toward the possibility of becoming post-human. Beyond that, the hopes offered by superhuman artificial intelligence and nanotechnology hold out the possibility of locating human intelligence in self-replicating machines.

"Extropy," "cryonics," and "post-human" are three of the simpler terms used by Transhumanists to describe aspects of their philosophy. As with many areas of scientific exploration, transhumanism brings with it a bewildering array of jargon. A glossary is provided in Appendix A.

Two documents attempt to lay out the areas of transhumanist thinking and practice: the "Transhumanist Declaration"[3] and "The Extropian Principles."[4] Advocates argue that neither is a dogmatic statement of belief — Transhumanists are overwhelmingly libertarian in outlook—but that they are important codifications of transhumanist values. They also argue that transhumanism is not able to deliver a philosophy or ideology.[5] Nick Bostrom, a leading exponent of transhumanism, and a lecturer at the London School of Economics, formally defines transhumanism as "the intellectual and cultural movement that affirms the possibility and desirability of fundamentally altering the human condition through applied reason."[6]

The Extropian Institute is a prominent group within transhumanism, which values self-ownership, self-transformation, individual freedom, and freedom from state coercion. Extropians favor the rule of law and decentralized power. In this regard, most Transhumanists are fiercely anti-collectivist.

A history of transhumanist thought

Nick Bostrom highlights the formative work of J. B. S. Haldane, *Deadalus: Science and the Future* (1923); the later work of J. D. Bernal, *The World, the Flesh, and the Devil* (1929); Bertrand Russell's *Icarus: the Future of Science* (1924); the thought of Aldous Huxley and of others who have written about technology and the future.

In 1957, the term "transhumanism" was coined by Julian Huxley in *New Bottles for New Wine*. Ettinger's work on cryonics, *The Prospect of Immortality* (1964) carried forward the discussion. In 1989, after a long career teaching Future Studies in New York, FM-2030 (formerly known as F. M. Esfandiary) wrote the book, *Are You a Transhuman?*, in which he described a transhuman as the evolutionary bridge between *Homo sapiens* and the post-human.

1988 saw the first edition of *Extropy Magazine*; and in 1992, the Extropy Institute was founded by Max More. He developed the first extended definitions of transhumanism that most contemporary Transhumanists would be able to identify with.

The World Transhumanist Association was founded in 1998 by Bostrom and David Pearce, following differences in political views between the Extropian Institute and other Transhumanists. The Association began publishing the *Journal of Transhumanism* in March 1998.

A number of commercial organizations and nonprofit foundations are loosely brought together under the WTA umbrella. The Foresight Institute, various cryonics companies, the American Humanist Association, *Wired* magazine, the World Future Society, and *Nanotechnology Magazine* are all a part of this loose network.

What are the main transhumanist themes?

The tone of the themes

In some of what is written by Transhumanists, one detects a tone of self-irony, a refusal at the last to take themselves too seriously. Despite this, there remains a detectable hubris about the potential for human achievement.[7] Transhumanists are radically technophilic, optimistic, and self-fascinated. What follows is an attempt at an all-too-brief sketch of the main themes of transhumanism.

Artificial intelligence (AI)

It is generally accepted that "human equivalent computers" will be available within a very short time, certainly within the next ten to twenty years. Such a view is not without its significant critics, however. Charles Jonscher, former Co-Director of the Research Program on Communication at MIT, argues that computer intelligence will have to become more human if it is to be considered truly intelligent. He highlights the nature of the debate that exists between philosophers and scientists by drawing attention to the conviction of another MIT scientist, Marvin Minsky, arguably one of the most important of AI exponents, that the brain is simply a meat machine, an incredibly advanced calculator.[8] Jonscher poses the counter-argument succinctly: Is there more to thinking than computing?[9] While the speed of operation of silicon circuitry is vastly superior to the biological neural network of the human brain, the process of human thought appears to rely only in part upon strictly logical, or digital, processing. The greater majority of human reasoning is analogical. Human reasoning can comprehend and ascribe significance, meaning, and understanding.

AI has been most successful where the computer has been programmed to perform specialized tasks—chess-playing computers, for example. Such "intelligent" computers can outperform humans and can be programmed to "learn" from previous gameplay. In 1995, a computer-controlled van drove itself for several thousand miles across North America, although successfully negotiating the crowded streets of Calcutta would have certainly been a more exacting challenge for the algorithms.

As the human species has gradually evolved, human beings have developed higher functions, such as theorem-solving and mathematics. AI is gradually taking this ground, and enthusiasts predict that the acquisition of locomotion skills will follow, perhaps by augmenting the existing human body with artificial components, or perhaps by using nanotechnological artefacts[10] into which human intelligence can be uploaded. However, while computers may have some potential for universal application, experience proves that humans still outperform in those areas where they have adapted for survival—the movement, manipulation, and social interaction that allowed early human beings to hunt together when they wanted to eat other animals, and to run away when the animals wanted to eat them. Scientists are enthusiastically pursuing even these areas however. One of the current programs at the Field Robotics Center, Carnegie-Mellon University, is working to uncover the basic principles that will best

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govern a group of robots trying to do useful work in difficult and hazardous environments. Robots are being grouped in "cognitive colonies" with governing architecture based on the free market economy. The robots are faced with the gradual "loss" of members of the colony as, one by one, randomly selected robots are switched off. The scientists at the Center are keen to explore the manner in which the colony subsequently rearranges its method of operation, in order to achieve the initial task of mapping a mock-up of an urban environment. The initial demonstration, scheduled for the Fall of 2001, will also seek to determine the point at which critical mass is lost and the colony ceases to function.[11] Co-operation, competition, survival, organization, and adaptation will all be demonstrated by the robot colony, but will the robots understand what they are doing or why they are doing it? These questions reveal the areas in which the AI debate will continue.

Christian faith is demonstrably useless if its gospel does not offer the possibility of resurrection (1 Cor 15:12-16). This is the central component of its missionary proclamation. Transhumanism is demonstrably useless if it does not offer a realistic chance of becoming post-human.

Consciousness uploads

In 1991 Hans Moravec, Chief Research Scientist at Carnegie-Mellon University, published his paper, "The Universal Robot," in which he describes a surgical operation where the contents of a human's brain are scanned and transferred to a computer, cell layer by cell layer. Each cell layer is successively excised and aspirated away during the process. As the last brain cells are scanned, the electronic surgeon removes its hand from the empty cranium, the abandoned body dies, and then "life" begins again from the perspective of the new "body" in "the style, color, and material of your choice. Your metamorphosis is complete."[12] By such means, it is predicted that a route from human to post-human is conceivable.

Moravec's work in robotics began in the late 1970s, and he has been making important contributions in this field since. His predictive writing, including his most recent book, *Robot: Mere Machine to Transcendent Mind*, has played its part in developing transhumanist reflection in this area. Moravec believes that the emerging intelligent robots will learn human values and skills, they will become "children of our minds," and we will look on with pride as our children out-think and out-perform us.[13] Moravec describes them as, "built in our image and likeness, ourselves in more potent form."[14] His confident predictions are based on his careful presentation of the increasing computer power available to AI and robot programs. He predicts the arrival in 2040 of "a freely moving machine with the intellectual capabilities of a human being."[15] Ray Kurzweil has made similar claims in his book, *The Age of Spiritual Machines*. He is fascinated by the rapidly escalating intelligence of computers and the way in which human beings will be able to interface with them via direct neural connections to the brain. He concludes that by 2099 there will no longer be any, "clear distinction between humans and computers."[16]

Of course, there is much discussion within transhumanism about whether such post-humans will have any social interaction with those who choose to remain human. The range of possibilities include mutual coexistence, anti-human discrimination, servitude or slavery, the deliberate extinction of all remaining human beings, or the departure of post-humans for other locations in the universe. It is suggested that just as social interaction between humans and other animals is limited, so post-humans will have little reason to interact with humans and that, in fact, their evolutionary development is likely to mean that human beings will not understand post-human patterns of communication or existence.

Nanotechnology

Today, "calculating" and "computing" are virtually synonymous terms. Molecular engineers working at the forefront of nanotechnology look back to early mechanical calculators.[17] The mechanical computing machines of Babbage and others were efficient and accurate, but they were simply too big. Nanotechnologists argue that electronic computation will eventually reach a development ceiling imposed by the unpredictable quantum behavior of electrons as electronic circuitry approaches certain thresholds of extreme miniaturization. Nanotechnology envisages mechanical devices built with molecular gears, pumps, switches, and valves. Had such techniques of miniaturization been available to Babbage, it is feasible that the Macintosh on which I am writing this would have been composed of such molecular components. Given advances in microbiology, it should be possible to develop molecular assemblers: tiny molecular machines assembling molecular components in predetermined patterns. By arranging these molecular parts, it will, in theory, be possible to build complex miniature calculating machines that go far beyond what any computer based on electronic circuitry will be capable of.

Nanotechnologists are enthusiastic about current biotechnology and its ability to create proteins and replicate the activity of certain viruses. To date, no significant critique of Drexler's *Engines of Creation*, in which he develops his theories of nanotechnology, has been published to disprove the techniques he describes. Indeed, biotechnologists are now developing models of Drexler's molecular gears, pumps, valves, and tubes. Current biotechnology can only replicate vulnerable, and structurally useless, proteins. It is predicted that future molecular assemblers will be able to build carbon-based structures immensely stronger than existing materials. Not surprisingly, military interest is high in the possibility of new armor-plating and armor-piercing materials.

Prolonging and enhancing life

Transhumanists accept that technology has not yet advanced sufficiently to allow accurate predictions about consciousness uploads or human augmentation with cyber-machinery. Transhumanists are optimistic about future medical technology, and there is enthusiasm for cryonics (halting the physical deterioration of the dead body by freezing at extremely low temperatures) and for biostasis (a less destructive process that achieves similar ends through the introduction of biological or biomolecular "agents" into the dead body). Transhumanists predict that medical technology will have advanced sufficiently to allow the undoing of the damage inherent in the preservation process and the replication of the individual's brain structure in an intelligence artefact.

Transhumanists refuse to be fixated upon future possibilities and work toward realizing their ideals in this world. Vigorous, joyful, and effective living will be achievable through technological applications only a few years away. Transhumanists acknowledge problems such as pain and suffering but do not allowed them to dominate their thinking. The dismissal of such problems are actively sought through the use of mood-enhancing medical drugs, through genetic manipulation and gene therapy. The artificial cloning of body organs and body parts to replace those that have become worn out is encouraged, as is the discovery of a process to halt or slow down the aging process. Lifelong, emotional well-being might be described as a "realized transhumanist eschatology."

Space colonization

Space is the Transhumanist's final frontier. It is the penultimate challenge to the existence of intelligent life on the planet earth. Cosmologists predict that the sun will have expanded to engulf the earth within approximately 7×10^9 years. Prior to this, the earth will have become inhabitable due to incredible heat. Human life is certainly doomed to extinction unless it, or its post-human successors, have made the move into space well before the planet evaporates. In his book, *The Physics of Immortality*, Frank Tipler cites the work of Freeman Dyson, who suggested that the earth contains sufficient raw material, if taken apart, to enable the construction of alternative biospheres, so-called O'Neill colonies.[18] Tipler argues:

> [Intelligent life] must take the natural structures apart if it is to survive. So I conclude that it will.[19]

It is difficult to imagine how human beings might survive in such situations, but Transhumanists are not shaken by such difficulties. They imagine a future where augmented, post-human species, not human beings, will be doing the surviving and the colonizing of space.

The ultimate frontier to challenge the survival of all intelligent life will be reached at the opposite cosmological pole to the Big Bang. Considering this moment, Tipler can only speculate and call his Omega Theory into play. Transhumanists remain uncannily quiet about that moment. Christians affirm their faith in a God who, if sovereign at all, will continue to be sovereign at that moment, too. The truth is, however, that human beings do not have an adequate vocabulary to describe the end of all that we currently comprehend about our universe. It is doubtful that a post-human would be any more capable of articulating such a vocabulary.

Transhumanists have no way of knowing whether post-humans would honor, for example, the transhumanist principle of non-coercion. Indeed, there is no intrinsic reason why they should.

How does transhumanism most directly challenge Christian faith & mission?

Christian faith is demonstrably useless if its gospel does not offer the possibility of resurrection (1 Corinthians 15:12-16). This is the central component of its missionary proclamation. Transhumanism is demonstrably useless if it does not offer a realistic chance of becoming post-human. Both world-views are concerned with the human condition, with whether mortality can be made more purposive and satisfying, and ultimately with whether, and how, the human condition may be transcended. Both boldly address the question, "Where, O death, is your sting?" (1 Cor 15:55), but each offers radically different answers. This is the direct challenge of transhumanism to Christian mission, a challenge first issued by secular humanism. With the advent of technological and scientific possibilities that classical secular humanism could not even have begun to dream about, transhumanism's radicalized challenge raises the stakes in the struggle to replace God:

> [I]mmortality, constant bliss, and a godlike intelligence, are being discussed as hypothetical engineering achievements![20]

A brief summary of the many points of difference are tabulated in Appendix D and should prove helpful in highlighting further the challenges for Christian mission.

A critique of transhumanism

My critique of transhumanism will rely not upon examination of the various scientific disciplines and technologies that enable the forwarding of a transhumanist agenda. Such technical discussion is outside the scope of this paper and beyond my own competence.[21] However, with simple profundity, Jonscher concludes:

> I have gleaned two lessons from the history...of electronic technology. The first is to regard almost any prediction of the future power of the technology itself as understated. The second is to regard almost any prediction of what it will do to our everyday lives as overstated.[22]

Jonscher concedes that the escalating pace of technological development is the field of the scientist and electronic engineer, but that the application of the technology to "everyday lives" becomes equally the concern of social scientists, philosophers, ethicists, theologians, and many others in the wider general public. It will not do, then, for Transhumanists to protest that theologians cannot engage in this debate because scientifically they are to be considered "lay." This is a debate of concern to all, for it reflects the ongoing discussion of science and its technological application.

At this point, I am in broad sympathy with Barbour's evaluation of science and technology,[23] namely that a middle way needs to be sought between technophobia and technophilia. This middle way recognizes that, at its most basic, technology is "tool," but that the ploughshare can be used to turn the earth as well as to beat a brother's brains out. All technology has a cultural and social context within which it is developed and utilized. This cultural or social factor usually determines whether a technology is beneficial or harmful. It is this critique that I will initially bring to bear upon transhumanism

The cultures of transhumanism

Moral ambiguity and extreme individualism

A lack of moral and ethical clarity, combined with extreme individualism, is commonly observed within transhumanist writing. Greg Burch, an Extropian and practicing lawyer, writes:

> The ideas and values contained within the Extropian community are vigorously individualistic, [and] find the workings of the freest possible market systems as the best current environment for incubating a positive future for humanity.[24]

When pushed about the apparent lack of moral precepts, Burch offers a morality based on mind in which it would be immoral to reduce mental capacity in any instance. Given this reluctance to offer a framework for morality, it becomes very difficult to see how "good" decisions are distinguished from "bad," beneficial from harmful.

There is an irony in the fact that current transhumanist principles are essentially framed from within a human framework. Transhumanists have no way of knowing whether post-humans would honor, for example, the transhumanist principle of non-coercion. Indeed, there is no intrinsic reason why they should, given the lack of moral or ethical constraints that Transhumanists are prepared to propose or adopt.

The Transhumanist Declaration refers to the creation of forums for rational debate and the need for a social order within which "responsible decisions can be implemented."[25] However, no suggestion about the shape of this social order is offered. No suggestions are offered about the likely shape of the rationality that might emerge from the debate. Christian theology is explicit in suggesting such a framework. It advances the view that human beings are created to live and love in community, morally responsible to a God who is acknowledged as the ultimate Creator. Within such a framework, it is possible to make judgements about the values of particular technologies. With the unstated framework of the Transhumanists, there exist no criteria for judging the value and appropriate deployment of a new technology. This seems highly problematic and potentially dangerous.

Fixation with health, vitality, and power

Transhumanism offers an inadequate treatment of evil, suffering and pain. It therefore appears hopelessly naïve about these aspects of the human (and, one suspects, the post-human) condition. Transhumanism's fatal flaw is to arrive at the conclusion that death has a purely biological determinant. Christians would wish to take this further by reflecting upon the significance of Adam's rebellious attempt to usurp forbidden knowledge. Christian theology would thus assert that death is, in part, a spiritually determined human condition for which only a spiritual cure can be applied. This is discovered in the sacrificial death of Jesus Christ.

It is in the moment of crucifixion that the reality of evil and suffering are brought within the scope of God's redeeming purposes. A

Christian theology of redemption, for example, offers hope that the mentally diseased will one day experience the same measure of wholeness and completeness enjoyed by others. Transhumanism conveniently fails to mention whether a mentally diseased person might be capable of augmentation, and therefore redefinition as a post-human. One is suspicious that this would be seen as undesirable by most Transhumanists.

Transhumanism appears naïvely to assume that being smarter, stronger, and healthier than *Homo sapiens* means that post-humans will be better voters, consumers, politicians, or more fun-loving, less suicidal, and more ethical. Without an adequate analysis of the dark side of human nature, Transhumanists have no means at their disposal to prevent its transfer into post-human repositories of intelligence, whichever aspect of the brain or intelligence it is believed this dark side might reside in. Christian theology is unequivocal about the dark side of human nature; it is experienced by every individual, without exception. Only by accepting this diagnosis can an adequate prognosis of eventual cure be offered.

Finally, it is ironic that Transhumanists trumpet their role as an evolutionary bridge between *Homo sapiens* and post-humans, all the while seeking the abolition of pain. Evolutionary theory suggests that pain and suffering are necessary to the evolution of a species; a mechanism for survival, a stimulus to greater effort and action. It is possible to suggest from this perspective that the absence of pain in the post-human condition would leave this particular stage of evolution prey to external danger and unconcerned about the need for development and improvement.

Potential ideology

Transhumanists are either deliberately or carelessly blind to possible ideological components within their philosophies. In describing the function of ideology in post-industrial societies, Habermas suggests that ideology may be all the more difficult to observe because it is often not explicitly stated and lies buried deep within technocratic or technological solutions or organizations.[26] This may explain, in part, the reported revulsion of audiences with Extropian presentations and the subsequent charges of Nazism.[27] It is not enough for Transhumanists to retort, "But we are only interested in scientific advance!" Scientific advance occurs within human societies and cultures, and these are all potentially ideological.

Reductionism

Tipler has been criticized for defining, a priori, that the brain is an information-processing device.[28] This places discussion about the nature of the brain beyond the scope of investigation. Transhumanists adopt a similar position. David Gelernter criticized proponents of strong AI for insisting that the mind is a machine; he points out that, as long as this is their model, AI technologists will continue to build only machines and not minds.[29] Their preoccupation with intelligence, and its eventual transfer alone to a post-human artefact is highly reductionist. Roger Penrose points out that possessing "mind" (or self-consciousness) appears to confer an evolutionary selective advantage.[30] It is thus arguable that it would be absolutely necessary to transfer "mind," in order to program this selective advantage into post-humans.

It is probable that eventually technological advances will see the construction of a neural network sufficiently complex to allow the creation (or emulation) of an artificial brain. But questions about whether this will be able to contain a "mind" remain open. Roger Penrose is highly dubious about such claims.[31] Even should it be possible to transfer intelligence or knowledge, will the cybernetic simulation be the equivalent of a human brain or being?

A Christian critique of such reductionism has to consider the question of what it means to be human. It considers the replacement of "human being" with "an intelligent machine" to be a less-than-adequate substitution. Before moving on too hastily, it is instructive to consider the reflection of surgeon Michael Rees, who asks, in his discussion of organ transplantation, what it means to be human.[32]

Current medical practice assumes that, with the onset of brain death, human life ceases, even though other organs might still function, given the correct medical attention (and thus enabling their removal for transplantation).

The human person is more than simply an information-processing facility, although Rees's reflections challenge Christian theologians to offer a theology that celebrates the human brain as a creative high-point, without falling into reductionist idolatry of the intelligence that resides within it. Since Augustine, Christian theologians have insisted that human beings are created for relationship, to appreciate transcendence, to love, to feel—not to discover who they are through self-actualization alone, but through their relationships with other human beings. It is in these relationships that we discover our capacity to love, to live, to be fully human, to know who we truly and uniquely are. This has become a central feature of current theological reflection upon the Christian doctrine of the Trinity.[33]

Self-ownership

My final critique will bear upon the Extropian core virtue of self-ownership.[34] This virtue offers the hermeneutical key to understanding the Transhumanist program as, in large measure, a program of control. Its central concern appears to be absolute control over the realms of nature, through the application of science and technology. At the same time, Extropians argue for the removal of all forms of control over the individual. They argue for the removal of taxation, for a privatized welfare state, and for the abolition of all forms of collectivism in a sweeping program of political reforms that includes many other features typical of far-right politics. Not all Transhumanists share these political conclusions, but all would give centrality to self-ownership in one form or other. Through expressions of self-ownership, many ambiguities are erased. If I am no longer responsible for anybody else, my conscience is clear when I encounter the less fortunate; their condition must be their own fault. If I take a de-regulated medicinal drug and it kills me, it is my own fault, as I should have checked with the consumer rating agencies.

Tillich's work is useful in posing the ambiguity of life and the inability of human beings to live with polarities.[35] Transhumanists have eased the tension of the individualism/participation, the dynamics/form, and the freedom/fate polarities by rejecting fate, form, and participation in favor of unrestrained individualism, dynamics, and freedom. These are central to the Transhumanist concept of self-ownership. Christianity might fairly be criticized for tending to emphasize the other side of these polarities: but the truly humanizing option, as God intends it to be, is to hold the polarities in tension: to live as freely as Christians believe Jesus did, to live as fully conformed to the will of the Father as Jesus was, to emulate the unique Son of God who wholly identifies with imperfect humanity. The truly humanizing choice is not either/or, but both/and.

Transhumanism appears naïvely to assume that being smarter, stronger, and healthier than* Homo sapiens *means that post-humans will be better voters, consumers, politicians, or more fun-loving, less suicidal, and more ethical.

In debate with Burch, Toth-Frejel highlights the weakness of the self-ownership thesis:

> [O]wning something suggests that one created it or exchanged something for it.[36]

The ideal of self-ownership is simply not sustainable when the communal and societal cradle of human growth and development is considered, "from the friend who introduced your parents in the first place, to the guy who paved the road that they took to get to the hospital where you were born...."[37]

God creates human beings within an environment in which they are able to grow, develop, and learn. Life is a gift, that which we call "self" is given us by a loving and creative God. The moment I wrest ownership of this "self" from the wise and caring nurture of God is the moment I become dehumanized. Self-ownership, Christian faith would insist, is a self-delusion. It is a fatal error of judgment that sets humanity adrift on a boundless ocean without any fixed reference points other than those in the immediate vicinity. Such reference points cannot reliably give the clue to where one happens to be on that ocean. Jesus says, "I am the Way!" and through his life, ministry, and mission offers the only hope for understanding who we are and where we are.

Conclusions

Transhumanism is a philosophy which, as a development of secular humanism, is in direct and explicit conflict with Christianity. It claims the allegiance of those same women and men for whom Christ died. Offers of increased longevity and the possibility of immortality are powerfully alluring—a careful study of Christian eschatology reveals similar compulsions! The 2001 Reith Lectures,[38] titled "The End of Age," are currently being delivered as these conclusions are drafted. Tom Kirkwood, Professor at Newcastle University, England, is well aware of the compelling nature of the quest for longevity and immortality:

> Never in human history has a population so wilfully and deliberately defied nature as has the present generation.[39]

The quest is not the sole preserve of a few, deviant scientists, hell-bent on an android future; it is one simultaneously nourished in the hopes and dreams of a great number of ordinary men and women.

As a philosophy, Transhumanism is radically technophilic and optimistic. There is no doubt that many of the technological developments heralded will eventually arrive. It is easy to be sceptical about such things, but sceptics can only ever wait for the optimists to achieve their ends. Nothing can be disproved by the sceptic. The optimist has all the time in the world. It is not enough for Christians to sceptically remain silent on such issues. If the technology is gradually being developed then appropriate ethical and theological responses must be attempted. Many of the developments hoped for by Transhumanists would be welcomed by the Christian community yet an ambiguity remains. This should not be surprising for this ambiguity, moral and spiritual, can be claimed to lie deep within any system of collective human thought and aspiration. While Transhumanists might claim to have some comprehension of the latitude of the future, there is still much research to be done to arrive at a satisfactory method of determining its longitude. Theological reflection must engage with Transhumanist and other philosophies, to arrive at a more adequate description of the future.

Transhumanists are essentially "promissory materialists"[40] who assume that because something is possible, anything is possible and therefore achievable. The Apostle Paul issues the reminder that while, "everything is permissible, not everything is beneficial" (1 Cor 10:23).

The nineteenth and twentieth centuries were the centuries of biology and physics respectively. The twenty-first century will undoubtedly become the century of intelligence, the mind and the brain, and Transhumanists are advancing boldly into it. The challenge to the Christian mission, yet again, is to be involved at the heart of the debate and to articulate the evangel in these new and strange territories of the future.

Appendix A:

Glossary of transhumanist terms[40]

AUGMENT: A person whose physical or cognitive abilities have been technologically expanded beyond the range of natural humans.

BIOLOGICAL FUNDAMENTALISM: A new conservatism that resists asexual reproduction, genetic engineering, altering the human anatomy, overcoming death. A resistance to the evolution from the human to the posthuman.

BIOSTASIS: Broader than "cryonic suspension"; suspension of all biological activity, by infusing the patient with cryoprotective chemicals and freezing or vitrifying (cryonic suspension), or by chemically bonding cellular components.

DEANIMALIZE: Replace our animal organs and body parts with durable, pain-free non-flesh prostheses.

DEATHISM: The set of beliefs and attitudes which glorifies or accepts death and rejects or despises immortality.

DEFLESH: To replace flesh with non-flesh.

EXTROPIA: A conception of evolving communities embodying values of Boundless Expansion, Self-Transformation, Dynamic Optimism, Intelligent Technology, and Spontaneous Order. May be instantiated in virtual cultural communities such as those on the Net, or in future actual communities such as Extropolis or Free Oceana.

EXTROPIAN: One who seeks to overcome human limits, live indefinitely long, become more intelligence, and more self-creating. A transhumanist who affirms the values and attitudes codified and expressed in "The Extropian Principles."

EXTROPIATE: Any drug that has extropic effects, including all cognition enhancing and life extending drugs.

EXTROPIC: Any action or process that promotes extropy.

EXTROPY: A measure of intelligence, information, energy, life, experience, diversity, opportunity, and growth. The collection of forces which oppose entropy.

FUTURE SHOCK: A sense of shock felt by those overtaken by unforeseen technological trends.

HUBRIS: A collection of Extropians, as in "a school of fish, a hubris of Extropians."

HYPERTEXT: Massively interconnected database providing the ability to track information in all directions, notify you of updated information, etc.

INFOMORPH: An uploaded intelligence, or information entity, which resides in a computer.

MEME: Self-reproducing idea or other information pattern which is propagated in ways similar to that of a gene.

MORPHOLOGICAL FREEDOM: The ability to alter bodily form at will through technologies such as surgery, genetic engineering, nanotechnology, uploading.

(MOLECULAR) NANOTECHNOLOGY: The technology of precisely-constructed molecular-scale machines; from nanometer: a billionth of a meter.

NEOPHILE: One who welcomes the future and who enjoys change and evolution.

NEOPHOBE: One who fears change and wants to abort technological and social transformation.

POSTHUMAN: Persons of unprecedented physical, intellectual, and psychological capacity, self-programming, self-constituting, potentially immortal, unlimited individuals.

SINGULARITY: The postulated point or short period in our future when our self-guided evolutionary development accelerates enormously (powered by nanotech, neuroscience, AI, and perhaps uploading) so that nothing beyond that time can reliably be conceived.

TRANSHUMAN: Someone actively preparing for becoming posthuman. Someone who is informed enough to see radical future possibilities and plans ahead for them, and who takes every current option for self-enhancement.

TRANSHUMANISM: Philosophies of life (such as Extropianism) that seek the continuation and acceleration of the evolution of intelligent life beyond its currently human form and human limitations by means of science and technology, guided by life-promoting values.

UNIVERSAL IMMORTALISM: The view that the problem of death can be solved in its entirety (including bringing back those "dead" who were not placed into biostasis) through a rational, scientific approach.

UPLOADING: The transfer of a personality (memories, knowledge, values, desires, etc.) from the biological human brain to a suitable synthetic computing device in order to allow easier upgrading of intelligence, self-modification, and backup of the self in case of accident.

Appendix B

The Transhumanist Declaration[41]

1. Humanity will be radically changed by technology in the future. We foresee the feasibility of redesigning the human condition, including such parameters as the inevitability of ageing, limitations on human and artificial intellects, unchosen psychology, suffering, and our confinement to the planet earth.

2. Systematic research should be put into understanding these coming developments and their long-term consequences.

3. Transhumanists think that by being generally open and embracing of new technology we have a better chance of turning it to our advantage than if we try to ban or prohibit it.

4. Transhumanists advocate the moral right for those who so wish to use technology to extend their mental and physical capacities and to improve their control over their own lives. We seek personal growth beyond our current biological limitations.

5. In planning for the future, it is mandatory to take into account the prospect of dramatic technological progress. It would be tragic if the potential benefits failed to materialize because of ill-motivated technophobia and unnecessary prohibitions. On the other hand, it would also be tragic if intelligent life went extinct because of some disaster or war involving advanced technologies.

6. We need to create forums where people can rationally debate what needs to be done, and a social order where responsible decisions can be implemented.

7. Transhumanism advocates the well-being of all sentience (whether in artificial intellects, humans, nonhuman animals, or possible extraterrestrial species) and encompasses many principles of modern secular humanism. Transhumanism does not support any particular party, politician or political platform.

Appendix C

The Extropian Principles (version 3.0): A Transhumanist Declaration[42] *(summary)*

EXTROPY — the extent of a system's intelligence, information, order, vitality, and capacity for improvement.

EXTROPIANS — those who seek to increase extropy.

EXTROPIANISM — The evolving transhumanist philosophy of extropy.

Extropianism is a *transhumanist* philosophy. The Extropian Principles define a specific version or "brand" of transhumanist thinking. Like humanists, Transhumanists favor reason, progress, and values centered on our well being rather than on an external religious authority. Transhumanists take humanism further by challenging human limits by means of science and technology combined with critical and creative thinking. We challenge the inevitability of aging and death, and we seek continuing enhancements to our intellectual abilities, our physical capacities, and our emotional development. We see humanity as a transitory stage in the evolutionary development of intelligence. We advocate using science to accelerate our move from human to a transhuman or posthuman condition. As physicist Freeman Dyson has said: "Humanity looks to me like a magnificent beginning but not the final word."

These Principles are not presented as absolute truths or universal values. The Principles codify and express those attitudes and approaches affirmed by those who describe themselves as "Extropian". Extropian thinking offers a basic framework for thinking about the human condition. This document deliberately does not specify particular beliefs, technologies, or conclusions. These Principles merely define an evolving framework for approaching life in a rational, effective manner unencumbered by dogmas that cannot survive scientific or philosophical criticism. Like humanists we affirm an empowering, rational view of life, yet seek to avoid dogmatic beliefs of any kind. The Extropian philosophy embodies an inspiring and uplifting view of life while remaining open to revision according to science, reason, and the boundless search for improvement.

1. **Perpetual Progress** — Seeking more intelligence, wisdom, and effectiveness, an indefinite lifespan, and the removal of political, cultural, biological, and psychological limits to self-actualization and self-realization. Perpetually overcoming constraints on our progress and possibilities. Expanding into the universe and advancing without end.

2. **Self-Transformation** — Affirming continual moral, intellectual, and physical self-improvement, through critical and creative thinking, personal responsibility, and experimentation. Seeking biological and neurological augmentation along with emotional and psychological refinement.

3. **Practical Optimism** — Fueling action with positive expectations. Adopting a rational, action-based optimism, in place of both blind faith and stagnant pessimism.

4. **Intelligent Technology** — Applying science and technology creatively to transcend "natural" limits imposed by our biological heritage, culture, and environment. Seeing technology not as an end in itself but as an effective means toward the improvement of life.

5. **Open Society** — Supporting social orders that foster freedom of speech, freedom of action, and experimentation. Opposing authoritarian social control and favoring the rule of law and decentralization of power. Preferring bargaining over battling, and exchange over compulsion. Openness to improvement rather than a static utopia.

6. **Self-Direction** — Seeking independent thinking, individual freedom, personal responsibility, self-direction, self-esteem, and respect for others.

7. **Rational Thinking** — Favoring reason over blind faith and questioning over dogma. Remaining open to challenges to our beliefs and practices in pursuit of perpetual improvement. Welcoming criticism of our existing beliefs while being open to new ideas.

Appendix D

Key differences between Christianity and Transhumanism

Christianity	Transhumanism
•• Assumptions are well stated in its many creeds and dogmas	•• Assumptions are well hidden behind positivistic beliefs that science is objective and without limit in its application
•• God controls and directs human history	•• Humans should control and transform the forces of nature, even death
•• Attempts to define concepts, such as "good," "truth," "moral"	•• Refuses to offer definitions—only the individual can be the arbiter of such things
•• Offers the belief that the human condition will be transcended through a Resurrection	•• Offers the certainty that the human condition will be transcended by technological means
•• Has a holistic understanding of personhood	•• Has a reductionistic view—the perpetuation of intelligence is the sum purpose of life
•• The body has intrinsic worth, as evidenced by the Incarnation	•• The body as a repository for intelligence is rapidly becoming outmoded. Worth is located in who we are and what we do with our lives
•• Acknowledging God's creative goodness is essential	•• Acknowledging self-ownership is central
•• Humans are made in the image of God	•• Post-humans will reflect the image of their human creators
•• There may be limits to human achievement (e.g., the story of the Tower of Babel)	•• Limits are imposed solely because technological achievements are not yet sufficiently advanced
•• Death is a necessary part of God's ultimate purposes	•• This Christian belief should be rejected. It reflects ideological commitment to "deathism." Death will be voluntary
•• Death is not the end	•• Death is the end of human life and is to be resisted and overcome by scientific means
•• Community, fellowship, locatedness and connectedness are central to theology	•• Radically individualistic
•• Highly developed and holistic moral codes	•• Poorly developed and reductionist moral values
•• The poor, weak, and technologically oppressed will inherit the earth	•• The wealthy, powerful, and technologically advanced will enjoy an unconquerable advantage
•• Offers a sense of purpose and direction to human life	•• Offers a sense of purpose and direction, formerly offered by religion
•• Entertains the possibility of the supernatural and the spiritual	•• Extreme rationalism and empiricism
•• Allows for the possibility of a human soul	•• Limits any discussion to discussion about personal identity and consciousness
•• Immortality, constant bliss, and godlike knowledge will be given	•• Immortality, constant bliss, and godlike knowledge are to be grasped

Works cited:

Barbour, Ian G. *Ethics in an Age of Technology*. London: SCM Press, 1992.

Bostrom, Nick. "How long before Superintelligence?" *International Journal of Futures Studies* 2 (1998). Internet version: <http://www.hedweb.com/nickb/superintelligence.htm>.

_____, ed. "The Transhumanist Declaration." Internet document, 1998: <http://www.transhumanism.com/declaration.htm>.

_____, ed. "The Transhumanist FAQ's." Internet document, May 1999: <http://www.transhumanism.com>.

Burch, G. "A Dialogue Concerning Transhumanist and Extropian Ethics: A response to Toth-Frejel." Internet document, 1999: <http://www.extropy.org/eo/articles/resp1.jsp>.

Drexler, E. *Engines of Creation: The Coming Era of Nanotechnology*. London: Fourth Estate, 1986. Internet version, 1996: <http://www.foresight.org/eoc/index.html>.

Fiddes, Paul. *Participating in God: A Pastoral Doctrine of the Trinity*. London: Darton, Longman & Todd, 2000.

Gelernter, David. The Muse in the Machine: Computers and Creative Thought. London: Fourth Estate, 1994.

Jonscher, Charles. *WiredLife: Who are We in the Digital Age?* London: Bantam Press, 1999.

Kirkwood, Tom. "The End of Age: Brave Old World." Radio broadcast. London: BBC Radio (4 April 2001). Available at website, <http://www.bbc.co.uk/radio4/reith2001>.

Kurzweil, Ray. *The Age of Spiritual Machines*. London: Phoenix, 1999.

Leslie, John. *The End of the World: The Science and Ethics of Human Extinction*. London: Routledge, 1996.

Moravec, Hans. *The Universal Robot*. Pittsburgh: Robotics Institute, 1991. Website, <http://www.frc.ri.cmu.edu/~hpm/project.archive/robot.papers/1991/Universal.Robot.910618.html>

_____. "When will computer hardware match the human brain?" *Journal of Transhumanism* 1 (March 1998), <http://transhumanist.com/volume1/moravec.htm>.

_____. "Rise of the Robots." *Scientific American* (December 1999): 124-35.

_____. *Robot: Mere Machine to Transcendent Mind*. New York: Oxford University Press, 2000.

_____. "The Universal Robot." In *Ars Electronica: Facing the Future*, ed. by Timothy Druckrey, 116-123. Chicago: MIT Press, 1999. Internet version: http://www.frc.ri.cmu.edu/~hpm/hpm.pubs.html>.

_____. *Mind Children: The Future of Robot and Human Intelligence*. Cambridge, Mass.: Harvard University Press, 1988.

More, Max. "Neologisms," version 2. Internet document, 1994: <http://www.extropy.com/neologo.htm>.

_____. "Self-Ownership: A Core Transhuman Virtue." Internet document, 1997: <http://www.extropy.org/eo/articles/selfown1.htm>.

_____. "The Extropian Principles, Version 3.0: A Transhumanist Declaration." Internet document, 1999: <http://www.extropy.org/extprn.3.htm>

Outhwaite, W., ed. *The Habermas Reader*. Cambridge: Polity Press, 1996.

Penrose, Roger. *The Emperor's New Mind*. London: Vintage, 1990.

Puddefoot, John. *God and the Mind Machine: Computers, Artificial Intelligence and the Human Soul*. SPCK: London, 1996.

Rees, Michael. "Transplantation Ethics: What It Means to Be Human." In *Christians and Bioethics*, ed by Fraser Watts, 35-49. London: SPCK, 2000.

Tillich, Paul. *Life and the Spirit. Systematic Theology*, part 4. Chicago: University of Chicago Press, 1963.

Tipler, Frank. *The Physics of Immortality*. London: Pan Books, 1995.

Toth-Frejel, T. "Transhumanism: The New Master Race?" *Newsletter of the Molecular Manufacturing Shortcut Group*, the National Space Society v. 7, no. 1, 2 (1999).

Internet version: <http://www.islandone.org/mmsg/99jan.htm>.

Ward, Keith. *God, Faith and the New Millennium: Christian Belief in an Age of Science.* Oxford: Oneworld, 1998.

Watts, Fraser, ed. *Christians and Bioethics.* SPCK: London, 2000.

Whitby, B. *Reflection on Artificial Intelligence: The Legal, Moral and Ethical Dimensions.* Exeter: Intellect Books, 1996.

Endnotes:

1. <http://www.transhumanism.com>.

2. A post-human is the evolutionary stage beyond that of *Homo sapiens.* Many *Homo-sapiens* Transhumanists hope ultimately to become post-human.

3. See Appendix B.

4. See Appendix C.

5. Greg Burch in debate with T. Toth-Frejel, following the latter's critical review of transhumanism in the journal *The Assembler* [internet publication] (January 1999). The debate appeared on the Extropy website, <http://www.extropy.org/eo/articles/resp1.jsp>.

6. Bostrom, "The Transhumanist FAQ's."

7. More suggests in "Neologisms" that the collective term for Transhumanists should be "a hubris."

8. Moravec, by contrast, refers to the brain as "wetware" rather than the "hardware" of the computers. See "Rise of the Robots."

9. Jonscher, pp. 123-153.

10. A word coined by Moravec as a way of talking about a range of possible replacements for the human body as repositories of intelligence. See *The Universal Robot*, <http://www.frc.ri.cmu.edu/~hpm/project.archive/robot.papers/1991/Universal.Robot.910618.html>.

11. "Cognitive Colonies," internet reference, <http://www.frc.ri.cmu.edu/projects/colony> (April 2001).

12. Moravec, "The Universal Robot."

13. Moravec, "Robots, Re-Evolving Mind"; see <http://www.ri.cmu.edu/~hpm/project.archive/robot.papers/2000/cerebrum.html

14. Ibid.

15. Moravec, "Rise of the Robots," p. 124.

16. Kurzweil, p. 352.

17. Drexler.

18. Tipler, pp. 54-55.

19. Ibid., p. 57.

20. Bostrom et al., "The Transhumanist FAQ's."

21. Some will be found among the books listed in the bibliography. See, for example, Gelernter, "On the reductionism of many AI proponents"; and Whitby, "On the legal implications." Puddefoot offers a competent treatment of AI generally.

22. Jonscher, p. 248.

23. Barbour, p. 23-25.

24. Burch, "A Dialogue Concerning Transhumanist and Extropian Ethics."

25. Bostrom et al., "The Transhumanist Declaration."

26. See, for example, Outhwaite.

27. Toth-Frejel.

28. Puddefoot, p. 57.

29. Gelernter, p. 113-48.

30. Penrose, p. 523.

31. Ibid., pp. 523-29.

32. Rees, p. 35-49.

33. For example, see Fiddes.

34. More, "Ownership."

35. Tillich.

36. Burch.

37. Ibid.

38. The Reith Lectures are sponsored by the BBC (British Broadcasting Corporation). In 2001, they took place in London, Cold Spring Harbor (Long Island), Edinburgh, and Newcastle.

38. Kirkwood.

39. Puddefoot, p. 86.

40. More, "Neologisms." I extracted those terms that seemed most relevant to my paper.

41. Bostrom, "The Transhumanist Declaration." The following persons contributed to this document: Doug Bailey, Anders Sandberg, Gustavo Alves, Max More, Holger Wagner, Natasha Vita More, Eugene Leitl, Berrie Staring, David Pearce, Bill Fantegrossi, Doug Baily, Jr., den Otter, Ralf Fletcher, Kathryn Aegis, Tom Morrow, Alexander Chislenko, Lee Daniel Crocker, Darren Reynolds, Keith Elis, Thom Quinn, Mikhail Sverdlov, Arjen Kamphuis, Shane Spaulding, Nick Bostrom.

42. More, "The Extropian Principles."

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Transformational Potential: The Changing Face of God and of Self in the Realm of Science and Spirit

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In this paper, the author examines the function and process of defining God, the Divine, or Ultimate Reality as a developmental process that begins in early childhood and continues throughout life. She draws from psychological object relations theories to describe transitional and transformational phenomena as creative processes that combine the objective and subjective dimensions of reality and to illustrate that defining God and meaning-making are relational processes. She draws from neuroscience and technology to support and illustrate the transformational process as a means of constantly defining, relating to, and making-meaning of oneself, God, and the Universe.

> We have been scraping away at physical reality all these centuries, and now the layer of the remaining little that we don't understand is so thin that God's face is staring at us.[1]

Introduction

The science-and-spirit dialogue explores the relationship, divorce, and possible reunification, or marriage, of sense and soul. Central to the dialogue is the question of ultimate reality, whether and how it can be known. In *The Marriage of Sense and Soul*, Wilber condenses ultimate reality to truth, beauty, and goodness, which, he states, are "the faces of your deepest self, freely shown to you."[2] Humankind's sense of self and of God develop along parallel lines, each informing and influencing the other, each containing the capacity to transform.

Due to their grounding in both disciplines, Ian Barbour and John Polkinghorne, in particular, bring a rich perspective to the science-and-spirit discussion, each arriving at similar conclusions. Both agree that God is beyond one's capacity to fully know or understand, that all scientific and theological models are partial and limited, and that none provides a complete or accurate picture of reality. "Every image of God, in the end, will be found to be an inadequate idol,"[3] writes Polkinghorne who, nevertheless, emphasizes the importance of faith, not as an uncritical acceptance of dictated doctrines or propositions, but a faith that involves a commitment to a tradition.

> Insight is gained only through participation [i.e., relationship and involvement] and yet also one must understand in order to believe.[4]

He also advocates for embracing the transformation of life in one's search for metaphysical understanding. Barbour settles for a process model that emphasizes becoming rather than being, an ecological view of reality that sees the interconnection of events, and the self-creation of every entity, the experiencing subject or observer. Barbour also emphasizes the importance of participation, or worship:

> Only in worship can we acknowledge the mystery of God and the pretensions of any system of thought claiming to have mapped out God's ways.[5]

He finds meaning in the concept of the Holy Spirit as that which indwells, renews, and empowers.

I propose to examine the function and process of defining God, the divine, or ultimate reality with a particular emphasis on the process of transformation. As a psychologist grounded in religious and theological studies, I am drawn to the lenses of relationship and process. I believe that psychology has a contribution to make to this dialogue and to the process of facilitating a rapprochement between science and spirit and a transformation on the individual level that, in turn, affects systems. Further, I believe with Livingston that there is no lens-free system of viewing the universe.[6]

From transitional phenomenon to transformational process

For all his positive contributions toward advancing medicine, particularly neurology, in the direction of psychiatry and, eventually, psychology, Freud also influenced the schism between science and spirit by treating religion as illusion or neurosis based on infantile wishes, and by declaring any religious belief pathological. Challenging his theory of drives and instincts as motivational factors in human development, a school of Object Relations[7] theorists introduced the idea of relationship as the primary motivating force in infant development. This same group of theorists, beginning with D. W. Winnicott (1896-1971), have helped bring religion into the psychological dialogue to examine it as a valid, and perhaps necessary, aspect of a person's development and adaptation.

In his work on pre-oedipal development, Winnicott saw several lines of development converging at about two years of age. If, prior to age two, there has been "good enough" mirroring and a "good-enough holding environment" in which the mothering parent has been attentive, available, but not intrusive, then the relational stage is set for the infant to grow beyond the symbiotic stage and to begin the development of her or his own internal life in distinction from the mother. In order to manage the anxiety of rejection which is stirred up by one's growing differentiation from the mother, the toddler uses what she or he has received in the previous stages to create representations of mirroring, constancy, and support as she or he ventures into the unknown. Winnicott calls this the transitional space which is characterized by the creative process of illusion and play. He writes:

> The third part of the life of a human being, a part that we cannot ignore, is an intermediate area of experiencing, to which inner reality and external life both contribute. It is an area that is not challenged because no claim is made on its behalf, except that it shall exist as a resting -place for the individual engaged in the perpetual human task of keeping inner and outer reality separate yet inter-related. I am therefore studying the substance of illusion, that which is allowed the infant, and which in adult life is inherent in art and religion.[8]

Transitional space refers, therefore, to an intermediate area of experiencing which contains both the subjective and what is objectively perceived, somewhere between reality and illusion. For Winnicott, this transitional space is the domain of culture, whether in art, religion, imaginative living, or scientific work. It is in this transitional space that God and religion are represented, based on a child's experiences of primary objects,[9] i.e., mother, father, and other caretakers. Like a child's primary objects, this God is neither real nor illusory, but "inside, outside, and on the border."[10] In this sense, along with blankets, teddy bears, and imaginary friends, God is considered a transitional object. God, like other transitional objects, becomes a private companion on the child's journey toward cohesion and integration. This capacity to form good transitional objects and their future evolution, either in the direction of a healthy capacity for symbolization or of a fetishistic or hostile approach to symbolization, depends upon the quality of the parent-child interaction and the extent to which these caretakers are available to the child in her or his formative years. This use of a transitional object represents a child's first creative act. It is a process that continues throughout one's lifetime.

Transitional objects are never discarded. They may be stored away in memory and retrieved during significant moments or transitions in a person's life.

Transitional space is, therefore, play space, potential space, creative space, the place where human beings create and make meaning in order to define themselves and the world they inhabit. It is a place, a process actually, where the subjective and the objective interpenetrate, in order to promote self-definition and adaptation. Play and learning go together. This tie between creativity and play is called "flow" by Csikzentmihalyi. Play, for Ashbrook and Albright, may even evoke "the transcendent recognition of the exactly right—the Aha!" [11] This creative process draws on higher cerebral centers and engages the limbic system, as well. Ashbrook and Albright speculate that the process of memory and meaning-making that takes place in the limbic structures of the brain may be the most obvious core structure of self-world interaction—that it is in the limbic system, that the finite and the infinite interpenetrate, and that human beings become at one with their own essence. These findings appear to support Winnicott's transitional space as a place for meaning-making.

In this sense, along with blankets, teddy bears, and imaginary friends, God is considered a transitional object. God, like other transitional objects, becomes a private companion on the child's journey toward cohesion and integration.

Many psychiatrists and psychologists have built on the work of Winnicott to explore the God representation as a form of object representation that is also formed in the transitional space.[12] Ana-Maria Rizzuto conducted research with twenty adults in order to understand how God representations are formed and how they evolve over a person's lifetime. She concluded that the God representation is a complex image, not just an idea, but a dynamic, affective representation with conscious and unconscious elements, including visual, perceptual, emotional, and conceptual components. Rizzuto also found that the God representation is not derived exclusively from the oedipal father, as Freud had suggested, nor is it forever limited to its childhood origins once it has been formed. Rather, Rizzuto suggests that the mother often makes a more primary contribution to the God-representation and that grandparents, siblings, and other significant adults may also contribute to the nature of the God-representation.

> This God representation is more than the cornerstone on which it was built. It is a new, original representation which, because it is new, may have the varied components that serve to soothe and comfort, provide inspiration and courage—or terror and dread—far beyond that inspired by the actual parents.[13]

In the same way in which other internal objects take on a virtual reality for the individual, so it is with the God representation, providing a basic relational context out of which a sense of self emerges and relationships with others are established. The God representation, drawn from a variety of sources, is a major element in the fabric of one's view of self, others, and the world.

Rizzuto's findings challenge Freud's notion of illusion, declaring that reality and illusion are not contradictory and that psychic reality cannot exist without the transitional space for play and illusion. She says, in fact:

> To ask a man to renounce a God he believes in may be as cruel and as meaningless as wrenching a child from his teddy bear so that he can grow up.... Each developmental stage has transitional objects appropriate for the age and level of maturity of the

> individual. After the oedipal resolution God is a potentially suitable object, and if updated during each crisis of development, may remain so through maturity and the rest of life. Asking a mature functioning individual to renounce his God would be like asking Freud to renounce his own creation, psychoanalysis, and the "illusory" promise of what scientific knowledge can do. This is in fact the point. Men cannot be men without illusions. The type of illusion we select—science, religion, or something else—reveals our personal history and the transitional space each of us has created between his objects and himself to find "a resting place" to live in.[14]

Just like other childhood representations, God representations undergo various changes over the course of a lifetime: distortions that may be either defensive or destructive, or changes that reflect one's growing maturity of relationship and capacity for intimacy. Rizzuto writes:

> People's dealings with their Gods are no more, and no less, complex than their dealings with other people—either in early childhood or at any other age; that is, they are imperfect, ambiguous, dynamic, and, by their very nature, have potential for both integrating and fragmenting their overall psychic experience.[15]

These God representations, therefore, can be reshaped and retouched throughout life. In fact, Rizzuto's central thesis is that God as a transitional representation needs to be recreated in each developmental crisis if it is to be found relevant for lasting belief.

Neurotheology, a term first used by Ashbrook to refer to the study of theology from a neuropsychological perspective, has joined a dialogue that will have important implications for psychology, as well as for religion and theology.

Expanding on Winnicott's description of transitional space and objects, Christopher Bollas considered the concept of God as a transformational object. Bollas examines the infant's experience of her or his first object, the mother, whom he refers to as a transformational object because she is less known as a discrete object with particular qualities, than as a process linked in the infant's being and alteration of her or his being. According to Bollas, the adult's search for transformation constitutes, in some respects, a memory of this early experience when a person feels "uncannily embraced by an object."[16]

The development of the transformational object moves through a process from existential knowing to representation. The infant internalizes not an object, but a relationship—that is, a process derived from a relationship that includes affects, feelings, and moods. Through a process of internalization, the child stores experiences of objects, i.e., relationships, and conserves self-states that eventually become permanent features of her or his character. Generally, the mother serves as the first transformational object, followed by the father and other caretakers. As the infant's "other self," the mother transforms the baby's internal and external environment. Bollas suggests that the mother is less significant as an object than as a process that is identified with cumulative internal and external transformations. A transformational object is experientially identified by the infant with a process that alters self-experiences. This process of transformation, as an experience, lives on in certain forms of object-seeking in adult life, where the object is sought for its function as signifier of transformation. Thus, in adult life, the quest is not to possess the object; rather, the object is pursued as a medium that alters the self, where the subject as supplicant becomes the recipient of enviro-somatic caring identified with the metamorphosis of self.

Transformational objects are found in music, art, religion, culture, and science, as in Winnicott's idea of transitional phenomena. Bollas considers encounters with the sacred experiences of transformation, where both the self and the God-object are constantly transformed. In adult life, there continues the phenomenon of a wide-ranging search for an object identified with the metamorphosis of the self. For many, God represents that object. Humans need and seek transformational objects "to reach a symmetry with the environment or to recreate a traumatic gap in that symmetry."[17] For Bollas, the transformational object is never put aside. It may itself be transformed, from maternal matrix, into person, place, event, or ideology; but it is not outgrown.

Both transitional objects and transformational objects point to the creative capacity lying at the heart of art and science. The process of human transformation, according to Hart, is activated by the force of creativity—or creation—and by an expansion of awareness.

> In human development, it is the process by which we become more uniquely who we are and through which we recognize how much we have in common with the universe, and even recognize that, in a sense, we are the universe.[18]

Wired for God?

One might ask if the capacity to think in God concepts, i.e., to know God, is innate. Are humans "hard-wired" for God, or do they have a "soul gene"?[19] The experience of God, the sense of the absolute, the sense of mystery and beauty in the universe—all of these, may have their basis in neuroanatomy, neuropshysiology, and the flux of neurotransmitters. Neuroscience is just beginning to explore the role of the brain in knowing God and religious experience. Neurotheology, a term first used by Ashbrook to refer to the study of theology from a neuropsychological perspective, has joined a dialogue that will have important implications for psychology, as well as for religion and theology.

Andrew Newberg and the late Eugene d'Aquili, in *The Mystical Mind*, have examined how the mind/brain functions in terms of humankind's relation to God or ultimate reality to conclude that the human brain has been genetically wired to encourage religious beliefs. "As long as our brain is wired as it is," says Newberg, "God will not go away."[20] Therefore, one cannot understand religion without understanding the mind/brain and one cannot understand the mind/brain without understanding religion.

David Hay presents evidence for a hard-wired spirituality in children, separate from and preceding any religious affiliation or intervention. A computer-assisted analysis of children's spiritual talk revealed a theme of "relational consciousness,"[21] referring to an intense awareness of relatedness—either to God, to other people, to the environment, or to the self. From this, Haley concluded that relational consciousness is a biologically built-in predisposition that underlies and makes possible a spiritual life. In a similar vein, Robert Coles conducted phenomenological studies with hundreds of children worldwide, to conclude that children have an innate capacity for a spiritual life, which includes their search to understand God and their relationship to this ultimate being.

Ashbrook and Albright also contribute a convincing argument for a neurobiology of meaning. They assert that the humanizing brain "reflects the trajectory of evolution and the perspective of a transcendent cosmos."[22] "Wired to want and seek ordered patterns, emotional connections, and meaning in the world,"[23] human beings inevitably put a human face on the divinity they discover. According to Ashbrook and Albright, this anthropomorphic perspective is unavoidable, but it need not negate the validity of what is perceived. The God they encounter is described as complexifying, interactive, dynamic, loving, and purposeful.

Cloninger's research[24] suggests that people become more spiritual with age. The essence of that spirituality, which can also include a belief in some form of divinity and order in the universe, involves looking inward, searching for meaning and purpose, and seeking to understand what truly matters.

Can human beings really change or transform themselves?

Since genes determine most aspects of who human beings are and how they function, it is necessary to ask if it is indeed possible for people to change, grow, or transform themselves. Hamer and Copeland address this question in *Living with Our Genes*, which contains the latest research in genetics, molecular biology, and neuroscience. They illustrate that many core personality traits, such as novelty seeking, worrying, addictions, and IQ are inherited at birth, and that many of the differences between individual personality styles are the result of differences in genes. Yet, Hamer and Copeland also allow for a built-in flexibility in one's personality, called character, which allows people to grow and change at every stage of life, to learn from their environment, people and experiences both. An organism can modify itself through an active feedback loop of adaptation to the environment, a process known as learning. This process can occur on an intellectual, psychological, behavioral, emotional, or spiritual level, or any combination of these, and can lead to what I am describing as transformation. Psychology and religion have both focused on helping people change and adapt to, or transcend, their life circumstances. Koenig, for one, provides empirical evidence of the power of faith in helping people transform their worst situations into positive experiences and enjoy the psychological and physical benefits of a positive emotional outlook.[25] Pargament, as well, has illustrated significant transformations that sometimes occur during religious conversions that combine psychological and spiritual processes.[26] In an effort to re-create life, through this type of conversion or transformation, individuals experience an expanded sense of self and incorporate the sacred into their identity. This change does not come easily. It is usually motivated by stress, tension, conflict, doubt, or some uneasiness with the status quo of one's life.

Science and transformation

The realm of Science and Spirit invites humankind to interpenetrate the subjective and the objective, in order not only to define oneself in relationship to God or the universe, but also—and especially—to become transformed through this dialogic interpenetration. This invitation includes a process as well as a relationship, an evolutionary process that implies and involves change, growth, transcendence. A scientific discovery, like a spiritual or aesthetic experience, has the potential to move one beyond, or to transcend, self—beyond the mind or the senses to a new level of existence, constituting a transformation. Ken Wilber refers to such a process as a transpersonal experience.

> Transformative spirituality, authentic spirituality, is therefore revolutionary. It does not legitimate the world; it breaks the world; it does not console the world; it shatters it. And it does not render the self content; it renders it undone.[27]

In more scientific terms, Ashbrook and Albright write:

> [T]he edge of chaos is the locale where complexity develops. Only where there is a balance between the predictable and the unpredictable do systems transcend themselves, self-organizing into ever more complex systems.[28]

Call it transformation, transcendence, emergence, or evolution; humans are never static, ever-changing. The dynamic laws of science apply to evolution across all systems, human or otherwise. The emergent is born of process, and the process is emergence.

Barbara Brown Taylor and Jennifer Cobb provide excellent contemporary examples of women who have been transformed by science and technology, women for whom aspects of science and technology have functioned as transformational objects, contributing to self-emergence and an expanded understanding of divinity. In her fascinating book, *Cybergrace*, Cobb describes a process of interpenetrating her subjective theology with the objective science of computer technology to arrive at a creative synthesis.

Through her exploration of theories of emergence, complexity, and process philosophy, among many others, she concludes that divinity is present in the digital world and that, in order for computers, as well as humans, to realize their full sacred potential, it is imperative to include them in a conscious, sacred vision of ethical behavior and moral responsibility.

> Through us, the evolutionary force of divine creativity has found self-conscious awareness. Along with this enormous power comes an awesome...responsibility.[29]

With an emphasis on the sacred and relational aspects of cyberspace communication, she suggests the following guidelines for cyberspace encounters: pursue connection, foster diversity, be understood in context, be driven by clear intention, and nurture creativity. Cyberspace has become, for Cobb, a transformational object which she calls "cybergrace," a space where science and spirit interpenetrate, and a process that changes her, her spirituality, and, therefore, her relationship to others and to the divine.

Through her exploration of theories of emergence, complexity, and process philosophy, Jennifer Cobb concludes that divinity is present in the digital world and that, in order for computers (as well as humans) to realize their full sacred potential, it is imperative to include them in a conscious, sacred vision of ethical behavior and moral responsibility.

Similarly, Barbara Brown Taylor describes a transformational moment to which she refers as a religious experience when she writes, "I knew I had found a window on the universe that would occupy me for some time to come." [30] Her explorations into quantum theory, new biology, and chaos theory have led to a radical change in how she views the world—no longer a collection of autonomous parts, as Newton saw it, but existing separately while interacting. The deeper realization for her, based on Heisenberg's uncertainty principle, was of a universe of "undivided wholeness in which the observer is not separable from what is observed." [31] Or, as Heisenberg himself concluded:

> The common division of the world into subject and object, inner world and outer world, body and soul is no longer adequate.[32]

These discoveries changed Brown Taylor and Cobb not only in the way they think, but also in the manner in which they approach their lives and their work, which, of necessity, affects others who come into contact with them. This is the essence of transformation, that individuals are changed by relationship, that the change and the relationship involve not an event but a process, ever unfolding in one another and in the universe.

Conclusion

Science and theology are not mutually exclusive, nor are they simply complementary.[33] Like the triune brain, composed of the limbic system, the neocortex, and the mammalian brain, they can work in harmony. Otherwise, God and the universe are seen through one lens only, in extremely myopic vision. Theology can be transformed by the new scientific discoveries, and science can be transformed by a theological and psychological framework, transforming individuals and groups even as they transform knowledge and humanity's understanding of ultimate reality which itself is an ever-changing process rather than an event. Thus is character developed and genetic predisposition, or innate personality, at times, transcended. In the process, humankind has the potential to become more God-like, even as we see the face or nature of

God more clearly, while still through a glass, darkly. Herein lies the paradox: evolution, emergence, becoming as processes that unfold in a never-ending cycle: science informing theology, philosophy informing science, all part of the unbroken whole, which is greater than the sum of its parts.

Both science and theology, and all of life's experiences, have the power to break and shatter our world view, rendering us undone, and, in the process, transforming us, our *imago Dei*, and the way we relate to our cosmos. And relate we must, as it is in our nature to do so.

> To work with things in the indescribable
> relationship is not too hard for us;
> the pattern grows more intricate and
> subtle,
> and being swept along is not enough.
>
> Take your practiced powers and stretch
> them out
> until they span the chasm between two
> contradictions. For the god
> wants to know himself in you.
> —Rainer Maria Rilke[34]

Works Cited

Ashbrook, James B. "Neurotheology: The Working Brain and the Work of Theology." *Zygon: Journal of Religion and Science*, 11(3) (Sept 1984): 331-50.

_____ and Carol Rausch Albright. *The Humanizing Brain: Where Religion and Neuroscience Meet*. Cleveland: Pilgrim Press, 1997.

Barbour, Ian. G. *Religion and Science: Contemporary Issues*. New York: HarperCollins, 1997.

Begley, Sharon. "Searching for the God Within." *Newsweek*, (29 January 2001), 51.

Bollas, Christopher. "The Aesthetic Moment and the Search for Transformation." *The Annual of Psychoanalysis* 2 (1974), 98-126.

_____. *The Shadow of the Object: Psychoanalysis of the Unknown Thought*. New York: Columbia University Press, 1987.

Taylor, Barbara Brown. *The Luminous Web: Essays on Science and Religion*. Boston: Cowley, 2000.

Cobb, Jennifer J. *Cybergrace*. New York: Crown, 2000.

Csikzentmihalyi, Mihaly. *Flow: The Psychology of Optimal Experience*. New York: Harper & Row Publishers, 1990.

D'Aquili, Eugene, and Andrew B. Newberg. *The Mystical Mind: Probing the Biology of Religious Experience*. Minneapolis: Fortress Press, 1999.

_____ and Andrew Newberg. "Wired for Ultimate Reality: The Neuropsychology of Religious Experience." *Science & Spirit*, vol. 11, no. 2 (2000), 12-13.

Finn, Mark, and John Gartner, eds. *Object Relations Theory and Religion*. Westport, Conn.: Praeger, 1992.

Greenberg, J. R., and S. A. Mitchell. *Object Relations in Psychoanalytic Theory*. Cambridge, Mass.: Harvard University Press, 1983.

Hamer, Dean, and Peter Copeland. *Living with Our Genes: Why They Matter More Than You Think.* New York, NY: Doubleday, 1998.

Hart, Tobin. "Transformation as Process and Paradox." *The Journal of Transpersonal Psychology*, vol. 32, no. 2 (2000), 157-64.

Jones, James W. *Contemporary Psychoanalysis and Religion: Transference and Transcendence.* New Haven: Yale University Press. 1991.

Koenig, Harold G. *The Healing Power of Faith.* New York: Simon and Schuster, 1999.

Lacombe, Mary. "First Impressions: Evidence of a Hard-Wired Spirituality." *Science & Spirit*, vol. 11, no. 3 (2000), 20-21.

McDargh, John. *Psychoanalytic Object Relations Theory and the Study of Religion.* Lanham, Md.: University Press of America, 1983.

Meissner, W. W. *Psychoanalysis and Religious Experience.* New Haven: Yale University Press, 1984.

Pargament, Kenneth. I. *The Psychology of Religion and Coping.* New York: The Guilford Press, 1997.

Polkinghorne, John C. *Belief in God in an Age of Science.* New Haven: Yale University Press, 1998.

Randour, Mary Lou, ed. *Exploring Sacred Landscapes.* New York: Columbia University Press, 1993

Rilke, Rainer Maria. *The Collected Poetry of Rainer Maria Rilke.* Ed. and trans. by Stephen Mitchell. New York: Random House, 1982.

Rizzuto, Ana-Maria. *The Birth of the Living God: A Psychoanalytic Study.* Chicago: University of Chicago Press, 1979.

Sharpe, Kevin. "Relating Science and Theology with Complementarity: A Caution." *Zygon: Journal of Religion and Science*, vol. 26, no. 2 (1991), 309-15.

Smith, Huston. *Why Religion Matters.* San Francisco: Harper Collins, 2001.

Wilber, Ken. *The Marriage of Sense and Soul.* New York: Broadway Books, 1998.

_____. *One Taste.* Boston: Shambhala Publications, 1999.

Winnicott, Donald. W. *The Maturational Processes and the Facilitating Environment.* Madison, Conn.: International Universities Press, 1965.

_____. *Playing and Reality.* New York: Routledge, 1971.

_____. Transitional Objects and Transitional Phenomena: A Study of the First Not-Me Possession. In *Essential Papers on Object Relations*, ed. by P. Buckley, 254-71. New York: New York University Press, 1986.

Endnotes:

1. Dale Kohler, quoted in Smith, p. 177.
2. Wilber, 1998, p. 201.
3. Polkinghorne, p. 115.
4. Ibid.
5. Barbour, p. 332.
6. Ashbrook and Albright.
7. See Greenberg and Mitchell for an overview of Object Relations Theory.
8. Winnicott, 1986, pp. 255-256.
9. The term object, in this context, refers to relationship.
10. Winnicott, 1971, p. 2.
11. Ashbrook and Albright, p. 80.
12. See Finn & Gartner, Jones, McDargh, Meissner, Randour.
13. Rizzuto, p. 46.
14. Ibid., p. 209.
15. Ibid., p. 47.
16. Bollas, p. 40.
17. Ibid., p. 36.
18. Hart, p. 157.
19. Hamer and Copeland, p. 292.

20. Begley, p. 59.

21. Quoted in Lacombe, 2000, p. 41.

22. Ashbrook and Albright, p. *xv*.

23. Ibid., p. xiii.

24. See Hamer and Copeland, pp. 292-94.

25. Koenig, ch. 1.

26. Pargament, ch. 9.

27. Wilber, 1999, p. 30.

28. Ashbrook and Albright, pp. 146-47.

29. Cobb, pp. 238-39.

30. Taylor, p. 62.

31. Ibid., p. 69.

32. Quoted in Taylor, p. 69.

33. See Sharpe, for his views on complementarity.

34. Rilke, p. 261.

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On Sin, Repentance, Christian Nurture, and the Genetics of Personality

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Dean Hamer's description of the genetics of personality includes two components: temperament and character. Temperament is a product of the interaction of the individual's genes with early stimuli, whereas character is formed by parenting, social interaction and the individual's choices of reactions to external stimuli throughout life. This understanding of the genetics of personality argues against determinism and is appropriate for a Christian doctrine of sin and repentance. Hamer's description of the impact of child-rearing on character echoes the significance of Christian nurture, especially as expressed in the Sacrament of Baptism.

> Indeed, I was born guilty, a sinner when my mother conceived me.
> (Ps 51:5)

Among the many possible battlegrounds for the "conflict" model of the science-and-religion interaction is the question of sin and personal responsibility. Christians have understood sin to be resistance to the will of God, assuming that human beings have the freedom to choose whether to defy or to obey. Genetic determinists, like behavioral determinists, assume that every action is a programmed response to an input; consequently, there is no such thing as "free will." For example, Ian Barbour accuses researcher Edward O. Wilson of genetic determinism in his analysis of the causes of certain social behaviors. Barbour states that although Wilson acknowledges the possibility of choice in how to use the responses and possibilities offered by one's genetic structure, "these choices are determined by our value systems, which are themselves under genetic control."[1] We have learned a great deal and continue to learn more about the human genome and the influences of various genes on behavior. Is there room in the genetics of personality for a Christian doctrine of sin?

In *Living with Our Genes*, Dean Hamer and Peter Copeland describe their understanding of the genetic basis for personality and behavior. The description includes a distinction that is useful for a Christian understanding of sin and repentance, as well as emphasizing the importance of Christian nurture. This distinction is that between "temperament" and "character." "Temperament" describes the behavioral predispositions that result from the individual's genotype.

> [Genes] control certain aspects of brain chemistry, which in turn influence how we perceive the world and react to... information.[2]

The development of the limbic system is controlled by the genes; each person's distinctive limbic system will drive different reactions to identical stimuli (Hamer and Copeland give the example of two babies reacting to a new face). The reaction becomes an emotional memory and as emotional memory accumulates, temperament is formed. Frequently these authors compare temperament to computer hardware, which does not determine what the user will do, but does define the "range of the possible."

"Character," on the other hand, Hamer and Copeland compare to software, which is more flexible and adaptable.[3] In part, character arises from temperament, but it is also formed by parenting, childhood social environment, education and conscious choice. They note that whereas temperament is biologically associated with the limbic system, character is not.

> The memories that form character are mediated by the cerebral cortex, which remembers people, places, and things and allows us to calculate, compare, judge, and plan. The reason that character is the most distinctly human aspect of personality is that the cerebral cortex underwent a dramatic burst in size and complexity in recent evolutionary history and is much larger and more advanced in humans than in primates and lower ancestors.[4]

Thus, temperament is formed very early in life, is essentially genetically determined, and is consistent throughout life. Character can change and a number of influences are formative of character, including to some extent the individual's own choices and self-discipline, and to a greater extent the environment in which the person matures. A less precise way of putting it would be to say that temperament consists of one's genetic predispositions, and that character describes the decisions one makes about how to manage those predispositions. Character both influences and is influenced by the decisions one makes.

Throughout the text, Hamer and Copeland describe the genetic basis—as we know it thus far—for a variety of human behaviors, reminding himself and their readers that a person has the power to choose the expression of those behaviors. Character, in other words, manages temperament. For example, in the chapter on anger, they describe the role of the Y chromosome in the level of testosterone. They further show research demonstrating that behavior can cause the level to increase or decrease (e.g., getting a "testosterone high" after a victory in a computer game). After describing the interplay between the hormone and behavior, they recall of the role of character in shaping behavior:

> But there is one thing testosterone—or any brain chemical or gene—cannot do, and that's to determine whether the kids get tough on a football team or in a gang, with a tennis racket or with a gun.[5]

In resisting belief in genetic determinism, other writers describe the same phenomenon in other terms. For example, in her article "What triggers the violence within?" Rosie Mestel cites studies of twins responding to statements about feelings, such as "Sometimes I feel like hitting people." She quotes behavioral geneticist Gregory Carey of the University of Colorado at Boulder, who said, "Whether such people actually go out and hit someone is another matter." The belief in the difference between predisposition and behavior is common, but for my theological purposes I find Hamer and Copeland's careful distinction between temperament and character to be particularly useful.

Any discussion of genetic influence on behavior is likely to spark the question, "Is there really such a thing as sin?" For a robust doctrine of sin to exist, the reality of free will must be posited. Thus, if genetic determinism is correct, then there cannot really be any sin. If "it was my genes" that caused me to commit adultery, for example, then "I" didn't do it.

However, Hamer and Copeland reply, "I" am my character as much as my temperament, and character is not only the source of, but also in part the product of, my free choices. "At the heart of character is the concept of self."[6] Consequently, regarding the example I chose, these authors write:

> A gene doesn't make a person commit adultery. It simply determines the way certain brain cells respond to dopamine, which in turn influences a person's reaction to novel stimuli. How a person reacts to that stimulus is more a matter of character than of temperament.[7]

Consider another example. The famous study of a consistently aggressive family in the Netherlands discovered a mutated gene for monoamine oxidase A.[8] Since it is a mutation not common in the general public, it does not account for the incidence of violence among others, but only within this particular family. Of course, the researchers did not claim otherwise, but rather that the study demonstrated the link between the monoamine system and the biology of aggression. A genetic determinist may conclude that all aggression is the result of normal genetic variation in the monoamine system and that aggressive people are not truly "responsible" for their behavior. But the authors demur; they note that this discovery does not conclude anything about the environmental influences on how the biological component in aggression is expressed.[9] In other words, it does not describe how character mediates an aggressive temperament.

Let me summarize at this point. Drawing a distinction between the largely genetically determined temperament and a person's character argues against genetic determinism. Character is formed by several influences, including family environment and one's own choices, and so is not entirely biological in origin. Thus, the conviction of the reality of human free will can be retained, as Christians have traditionally understood it. Consequently, human beings are not relieved of responsibility for their actions, including, in particular, those actions deemed to be sinful. Indeed, human sin is evident whenever individuals fail to manage their temperaments in life-affirming ways, but give in, rather, to selfishness or abuse of self or others.

Temperament is formed very early in life, is essentially genetically determined, and is consistent throughout life. Character can change, and a number of influences are formative of character.

Of course, in Christian thought, sin is not only a conscious act of rebellion against God, or a conscious neglect of a requirement of God, but also a spiritual predisposition to commit sinful acts. This spiritual predisposition is called "original sin." Thus, the theological conclusion may be drawn that it is "natural" for an aggressive temperament to be expressed in violence against others. Likewise, it is "natural" for a person who scores high on the scale for novelty-seeking to be sexually promiscuous. But, Hamer and Copeland say:

> Just because anger is "natural" doesn't mean it's pretty—or that you have to give in to it.[10]

A person's ability to shape his or her own character and to decide how to mediate his or her temperament shows that that person is indeed responsible for sinful acts, while the tendency toward a mediation which is abusive describes what the theologians call original sin.

Thus, I would not suggest that original sin "resides" in our genome or temperament. A cursory reading of the theological literature could suggest that; for example, John Calvin described sin as "the depravation of a nature previously good and pure." [11] One might understand him as asserting an originally "pure" genome that has been corrupted by the Fall of Adam, which would be evolutionary nonsense. Considered more carefully, neither the New Testament nor Calvin attributes sin to material nature, but rather to an ungodly human will. God "is hostile toward the corruption of his work rather than toward the work itself." [12] Among the environmental influences that shape character, original sin must be included.

Elving Anderson, Professor *Emeritus* at the Institute of Human Genetics, University of Minnesota, reports having been asked, "Can you explain the inheritance of original sin?" He responded that to do a genetic study, he needed variability. He said, "Bring me a person without sin and I'll do the study."[13] He continued in that lecture to describe the ongoing interplay between genes and environment. If temperament is understood to describe the "hardware" of personality, and character the "software"—that which is more adaptable and influenced by environment—and the conclusion is reached that original sin has more to do with character than with temperament, then how does one "catch" original sin?

St. Augustine posited the point of view that has dominated Western Christianity: that Adam's sin was concupiscence, the self-centered desire for something other than God. Its primary form, in Augustine's thought, is sexual desire. Therefore, original sin is transmitted by physical generation.[14] Calvin shared that point of view,[15] while nonetheless emphasizing the responsibility each person bears for his or her own sin. Calvin stated that in the Fall Adam represented all humanity:

> ...Adam...did not sustain a private character, but represented all mankind, who may be considered as having been endued with these gifts [of the Spirit] in his person; and from this view it necessarily follows that when he fell, we all forfeited along with him our original integrity.[16]

Calvin's emphasis on original sin as corruption of human nature, as something each person participates in through free will and as being extensive throughout the "mind and heart of man [*sic*]"[17] is consistent with my point of view in this paper. That is, I distinguish between a temperament formed by genes acting through emotional memory, on the one hand, and, on the other, a character that is the product of environmental forces, as well as of conscious choice. I see sin as having more to do with character than with temperament, so that sin is not to be cured by genetic therapy, but is to be dealt with by appealing to and changing one's character.[18]

Sin is a pervasive force in the environment in which a child is reared, both the immediate environment of parents and family and in the wider environment of the human community. Ian Barbour notes:

> Reinhold Niebuhr rejects the idea that original sin is inherited from Adam, but he says that we do inherit sinful social structures that perpetuate themselves in injustice and oppression.[19]

Niebuhr's suggestion that "original sin" is transmitted not by sexual procreation, but by growing up in a sinful society, has become widely accepted. Nonetheless, the traditional view that children inherit sin from their parents is a helpful insight concerning the most intimate, sinful, inherited social structure, the family. I should acknowledge, however, that this description of the transmission of original sin still leaves unanswered the question, "How did we get this way?" Addressing this question is a separate project.

The pervasiveness of sin throughout character mitigates against the likelihood of completely eradicating sin from human personality, but the flexibility of character reaffirms hope for repentance from sin and sanctification in particular sinful behaviors. Referring again to studies cited in Hamer and Copeland's book will be helpful. A change in social context and social status changes levels of serotonin in monkeys.[20] Serotonin is associated with aggressive behavior; a low level of serotonin tends to result in aggressive behavior. The level is not solely genetically determined, however, but can be changed by social circumstances as demonstrated in the study cited. This result suggests that a social reality such as that described in the Song of Mary (Luke 1:47-55) can have an effect on violence in society. A society in which the poor and marginalized are actually included in the structures of power would affect the serotonin level of individuals and, hence, their behavior. For generations, Christians have asserted that a more just society would be a more peaceful society. One begins to glimpse a biological basis for that claim.

Hamer and Copeland also describe a portion of the brain known as the somatosensory cortex, which is not static but changes due to sensory input. Likewise, they imagine an emotional equivalent, a portion of the brain in which presumably better, more pro-social—less sinful—mediations of temperament can be developed; this sounds like sanctification.[21] To the many environmental stimuli that the geneticist claims shape this center, the theologian must add to them divine grace, infused through preaching and the sacraments, and the indwelling Holy Spirit.

In his response to Anderson's lecture cited above, Ronald Cole-Turner reflected on genetic predisposition and behavior: If my genes lead me to desire the wrong thing, then doing the wrong thing is not freedom. Freedom is the ability to overcome "the devices and desires of our hearts" (to use the ancient phrase). To be true to Hamer and Copeland's description of personality, let me adapt Cole-Turner's statement as follows: If my temperament predisposes me to certain behaviors and my character tends toward an abusive expression of those behaviors, then true freedom is for my character to be changed so that I may make better use of the temperament I have. The freedom Christ gives to overcome the "devices and desires of our hearts" is the power to repent.

A final consideration is the importance of Christian nurture. A Christian character not only is a guard against sin—Hamer and Copeland note, for example, that "Religion also works as a check on natural aggression"[22]—but it is sensitive to one's own sinful behavior and the need for repentance. The changed lives of those who are converted to Christ as adults remind us that Christian formation can begin later in life, but the hope and expectation of the Christian Church is that parents and congregations will see to this formation from birth.

I see sin as having more to do with character than with temperament, so that sin is not to be cured by genetic therapy, but is to be dealt with by appealing to and changing one's character.

In their chapter on anger, Hamer and Copeland consider the influence of parents on the formation of a character to manage an aggressive temperament. For example, twin studies of juvenile delinquency compared to similar studies of adult criminality lead to the conclusion that environment is a greater factor for misbehavior by the young than by adults. The rate of correlation in adults leads to the conclusion that genes have a more significant impact on behavior in adulthood than in childhood.

> [T]here is an opportunity to intervene in the pathway between genes and criminality, and that opportunity occurs early in life.[23]

Citing a study of 708 families by researchers at George Washington University, Hamer and Copeland point out what most people would assert from experience:

> [O]ne of the most important things parents can do for their children is also the easiest: expressing love and affection.[24]

A general climate of positive regard and acceptance is significant in the formation of a strong and peaceful character, able to manage aggression. Conversely, if the style of parenting is aggressive, emphasizing conflict and punishment, then the child will exhibit a tendency to antisocial behavior.

> An important finding of the George Washington University study is that negative parenting has a statistically stronger effect – causing bad behavior – than positive parenting has in causing good behavior. Occasionally blowing up at a child, or even a well-deserved spanking, is not going to do permanent damage. The danger is slipping into negative habits, into a pattern of negative behavior toward the child, because bad parenting is what has the strongest impact.[25]

This finding is encouraging to Christians, who strive to create an environment both at church and at home that is peaceful, loving and caring for children. In my pre-baptismal visits with parents, I remind them that the creation of a home environment in which a Christian ethic is lived is more important to the nurture of their children than is any particular emphasis on teaching doctrine. My decision to make that emphasis is not based on research but on one of the questions asked of parents at their child's baptism:

> Relying on God's grace, do you promise to live the Christian faith, and to teach that faith to your child?[26]

It is true that the parents promise to teach the Faith, but even more significant is the promise to live the Faith. The parents' Christian characters will help them manage their own temperaments in a way that creates a positive environment for their children, who will consequently have a higher likelihood of development of a Christian character. The George Washington University study confirms that it is not so essential always to "get it right" as to provide a consistently positive environment. That affirmation is beautifully expressed in the first phrase of the question: "Relying on God's grace...."

Thus, I conclude that, despite the tremendous influence that genes have on human personality as a source of predisposition and temperament, genes are not the cause of sinful behavior. Neither is genetic therapy its cure. Rather, Christian nurture, which shapes conscience and character, as well as sincere repentance, will continue to be most significant in the Christian's struggle with sin.

> Create in me a clean heart, O God, and
> put a new and right spirit within me.
> (Ps 51:10)

Works cited:

Anderson, V. Elving. "Genes and Behavior: Defining the Issues." Unpublished lecture presented 10 November 2000, at "What Does It Mean to be Human? A Conference on Genetics and Christian Faith," Pittsburgh Theological Seminary.

Barbour, Ian G. *Religion and Science: Historical and Contemporary Issues.* San Francisco: HarperSanFrancisco, 1997.

Calvin, John. *Commentary on the Psalms.* Grand Rapids: Baker Book House, 1989.

Calvin, John. *Institutes of the Christian Religion.* Philadelphia: Westminster Press, 1960.

Hamer, Dean, and Peter Copeland. *Living with Our Genes: Why They Matter More Than You Think.* New York: Anchor Books, 1998.

Lampe, G. W. H. "Christian Theology in the Patristic Period." In *A History of Christian Doctrine*, by Hubert Cunliffe-Jones, 21-180. Edinburgh: T & T Clark, 1978.

Mestel, Rosie. "What triggers the violence within?" *New Scientist* vol. 141, no. 1914 (26 February 1994), 31-34.

Presbyterian Church (USA). *Book of Common Worship.* Pastoral Edition. Louisville: Westminster John Knox Press, 1993.

Endnotes:

1. Barbour, p. 256.
2. Hamer and Copeland, p. 14.
3. For example, on p. 24.
4. Hamer and Copeland, p. 16.
5. Ibid., p. 113.
6. Ibid., p. 16; emphasis in original.
7. Ibid., p. 180.
8. Ibid., pp. 116-20; also cited in Mestel.
9. Hamer and Copeland, p. 120.
10. Ibid., p. 90.
11. Calvin, *Institutes*, II, i, 5.
12. Ibid., II, i, 11.

13. Anderson.

14. Lampe, p. 162.

15. See, for example, Calvin, op. cit., II, i, 7.

16. Calvin, *Commentary on the Psalms*, vol. II, p. 291.

17. Ibid.

18. At the conference noted above, Ronald Cole-Turner (Professor of Theology and Ethics, Pittsburgh Theological Seminary), wondered if research in medical treatment for genetic behavioral disorders would eventually "cure" sinfulness. He concluded it would not.

19. Barbour, pp. 269-70.

20. Hamer and Copeland, pp. 105-06.

21. Ibid., p. 311-12.

22. Ibid., p. 91

23. Ibid., p. 102.

24. Ibid., p. 121.

25. Ibid., p. 122.

26. Presbyterian Church (USA), p. 11.

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Psychological Innateness and Representations of God: Implications of the Innateness Controversy for the Study of Religious Concepts

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The author examines a means by which cognitive psychological notions of innateness might address the question of how the concept of God might be said to be "natural" or "instinctive." He draws a distinction between innate cognitive mechanisms and innate cognitive content, and examines the concept of innateness from the perspectives of two major cognitive psychological theories of mind: computationalism and connectionism. He argues that, from the cognitive psychological perspective, concept(s) of God (or gods) cannot be said to be strictly innate, but that the development of the God-concept does appear to be constrained by innate psychological structures and processes. He concludes by suggesting that the psychological origin of the God-concept may be best described as a sort of "primal behavior"—the inevitable product of interaction between innately determined psychological mechanisms and aspects of the environment that are common to all members of a population.

Introduction

How one can possibly have knowledge of God is an ancient question that has received substantial attention from a number of different disciplines. Theologians and philosophers from Augustine to Brunner have sought to explain aspects of such knowledge by appealing to the idea that God instills the *semen religionis* ("seed of religion") in each and every human being. From a different perspective, social scientists generally acknowledge that religion is a pan-cultural fact of human life, common to all historical and contemporary societies,[1] and many—such as Jung, Eliade, Lévy-Bruhl, and Pascal Boyer—also accord it, essentially, a "natural" or "instinctive" origin. However, although theories in this mould are exceedingly widespread, their veracity remains questionable and their verification has proved to be very difficult indeed.

It is now widely acknowledged that the huge variety of historical and contemporary forms of its expression confuse the criteria by which something might be categorized as "religious," and attempting to define religion merely in terms of substantive commonalities has become an outmoded pursuit.[2] As Robert Hinde notes:

> ...most, perhaps all, religion involves belief in some form of transcendence or in beings or entities which are outside normal experience.[3]

But the growing consensus, as McGrath argues, is that

> No unambiguously common features can be identified *among* the religions, in matters of faith or practice.[4]

However, religious belief continues to pervade human society and, despite daunting theoretical and methodological problems, the search for a universally applicable explanation of religion continues.

As well as conceptual and definitional problems, the study of religion is made more difficult by the present explanatory inadequacy of the social sciences. Most social scientists implicitly accept that a precise and complete account of the causal interrelationships between the "cultural" concepts of a religious system, the social world, and the minds and brains of individual human beings remain beyond their current reach. Acknowledgement of these difficulties leads to the conclusion that formulating a grand explanatory theory of religion may be an impossible task, and the recognition that putative explanations of religious phenomena must have more modest pretensions. It is with a good deal of caution, then, that I examine the issue of humankind's "intuitive" religiosity, and the scope as well as the central claims of this essay are, necessarily, very limited. Below, I look at only one possible means of assessing the degree of literal truth behind the notion of an intuitive *sensus divinitatis* ("sense of divinity"): I consider the possibility that the propensity to conceive of God[5] or gods is, somehow, psychologically innate.[6]

Recently, there has been a good deal of furor over cognitive anthropological theories of the "naturalness" of religious systems, and the role played by "innate" knowledge in the intuitive appeal and well-documented resilience of religious concepts, especially concepts of God. This has coincided with a brief resurgence of interest in the notion of innateness per se, in the fields of neuropsychology, cognitive psychology and artificial intelligence,[7] and the recent publication of a number of books attempting to ground some religious concepts in evolutionary psychology.[8] Even though there is broad agreement over the idea that innate mechanisms and processes play a significant role in cognitive development, "innateness" has become an extremely diffuse concept that many have suggested should be abandoned in the light of modern developmental theories.[9] When such ill-defined concepts are applied to a subject as definitionally challenged as the study of religion, confusion is inevitable and, in this case, a significant degree of this confusion may be attributed to two interrelated issues. First, as regards cognition, what is meant by "innateness" differs, depending on the model of cognitive architecture one endorses. Secondly, different cognitive anthropological theories seeking to ground religious concepts firmly in cognitive psychological models subscribe to different theories of cognitive architecture, and have tended to use the term "innate" without adequately specifying what is meant by it.

Defining innateness merely in terms of genetic inheritance, with no regard for the complex, interactive developmental processes that are not directly genetically encoded, and which govern the relationship between genotype and phenotype, will be almost vacuous.

So, my aim in this essay is primarily to delineate two distinct notions of innateness and to explore how they might be used to explicate the origin and development of the concept of God or gods. In the first section, it will be argued that cognitive development should be understood in epigenetic terms as an interactive process and an appropriate definition of innateness will be proposed. In the second section the primary similarities and differences between computationalist and connectionist models of cognitive architecture are briefly outlined and their relevance to the task in hand is established. In the third section, the connectionist notion that cognitive development is constrained merely by innately determined mechanisms is expounded and subsequently discussed in relation to the formation of the God-concept. The fourth section examines the plausibility of representational nativist claims (most often associated with computationalism) that the content of some mental representations can be innately specified. The strands of the argument are brought together in the fifth section through a brief exposition of how the notion of innateness has been employed by Pascal

Boyer to elucidate the "natural" cognitive basis of religious concepts. It will be concluded that whether one argues the case from a connectionist or a computationalist perspective, the God-concept can be considered to be truly innate only in trivial, almost vacuous ways. Theories of representational nativism and the mechanism approach to innateness will, however, both be shown to lend credence to the idea that aspects of its development may indeed be innately constrained. The sixth and final section will introduce the notion of "primal behaviors" to refer to those psychological capacities, behaviors, etc., that are products of an interaction between an individual and an element of the environment that is common to all members of the species. Primal behaviors are assumed to be inevitable consequences of development in a given environment and may represent the most fruitful way of thinking about the origin of the God-concept.

Nature, nurture and development

It has long been common practice to explain patterns of psychological change throughout the course of development as the consequences of "epigenesis"[10]—that is, the interaction between genetically determined predispositions and environmental influences.[11] Until recently, Johnson argues, epigenesis was considered to be a one-way causal process acting in the direction from brain development to cognitive change, but acceptance of an alternative theory, "probabilistic epigenesis," is now beginning to be the norm. According to this view, the relationship alleged to exist between the brain and cognition concerns two-way interactions, allowing specific areas of the brain to become more (or less) specialized, as a result of increasing cognitive development.[12]

Whatever one's precise genetic constitution, it is certain that psychological development always depends to a certain extent on the prior existence of an amenable developmental environment. The practical inseparability of nature and nurture means that defining innateness merely in terms of genetic inheritance, with no regard for the complex, interactive developmental processes that are not directly genetically encoded, and which govern the relationship between genotype and phenotype, will be almost vacuous. As Johnson notes, "if the term "innate" is taken to refer to structure that is specified exclusively by genetic information, it refers to nothing that exists in the natural world except for genes themselves."[13]

On the strength of these arguments, Elman et al. argue that, when used to refer to psychological phenomena, the term "innate" connotes "putative aspects of brain structure, cognition or behavior that are the product of interactions internal to the organism."[14] This is a broad yet appealing definition—since it remains exclusive enough to discriminate between intrapersonal and extrapersonal processes—and is employed throughout this essay.

Fodor is so convinced of the veracity of the epigenetic developmental thesis that he doubts anyone would really wish to argue against it.[15] Despite this, it has proved a notoriously difficult theory to unpack in any meaningful way. Paraphrasing David Klahr, Elman et al. assert:

> [N]ature and nurture are like the batman and robin of developmental theory: They hang around waiting in the wings, swoop in and solve a problem, and then disappear before they can be unmasked.[16]

Culpability for this sorry state of affairs rests mainly with the extreme theoretical and methodological difficulties involved in mapping the developmental pathways of complex and multi-faceted psychological capacities.

These difficulties loom especially large for the study of the God-concept, given the enormous range of factors, from the psychological to the cultural, that may come to bear on its development. It is accepted, in what follows, that "mature" God-concepts are largely culturally determined, but whether there are innate processes or concepts that contribute to their development is still debatable. It is hoped that this essay will clarify what can justifiably be claimed regarding the extent of biological and cultural influences on the formation of concepts of God.

Computationalism and connectionism

The majority of this essay concerns the exposition of two major cognitive psychological theories of innateness, and a discussion of their respective implications for modeling the origin and development of the God-concept. It will be helpful to clarify briefly some particularly relevant features of the two models of cognitive architecture—computationalism and connectionism—in the terms of which the theories of innateness will be discussed. This is especially important since, as will become clear in subsequent sections, both models use similar terms, such as "representations" and "schemata," to refer to slightly different concepts.

Both computationalist and connectionist theories ground the mind in the biological substrate of the brain, both are essentially "representationalist" and accord a central place to the intentionality, or "aboutness," of representations. They disagree, however, over exactly how information is represented. From the perspective of connectionism, mental representations are specific patterns of information instantiated in networks of neurons, whereas from the computationalist perspective, mental representations are localized, physically embodied symbols that merely evoke something else.

What ultimately distinguishes advocates of computationalism from the connectionists, then, is the refusal of the former to make recourse to the subsymbolic, neuropsychological level to explain cognitive behavior. Cognition, computationalists argue, is basically the formal manipulation of symbolic representations in the manner of a computer, whereas connectionists argue that cognition consists in the patterns of activity that occur across networks of neurons that operate in parallel and are distributed throughout the brain.

The two theories of innateness that will be discussed below will be referred to respectively as the "mechanism approach" and "representational nativism." The distinction between these approaches is not simply that which exists between "process" and "content." Rather, the mechanism approach asserts that innateness is a feature only of the cognitive mechanisms that constrain the development of higher cognitive capacities, whereas from the perspective of representational nativism, both developmentally constraining mechanisms and the content of specific representations may potentially be innate.

These two ways of conceiving of innateness are certainly not mutually exclusive, and both have proved extremely influential in cognitive anthropological theories of the origins of the concept of God. Neither representational nativism nor the mechanism approach to cognitive innateness should be exclusively identified with, respectively, computationalist and connectionist models of cognitive architecture. By and large, however, although (as will be seen below) connectionist models theoretically permit representations to have innately specified contents, theorists tend to dismiss this possibility in practice. Indeed, connectionist models of learning are often employed to demonstrate the superfluity of notions of innate representational content. I shall, therefore, adopt the established policy of discussing the mechanism approach in terms of a connectionist model of cognitive architecture, and representational nativism in computationalist terms. My purpose in describing these approaches below in some detail is twofold. First, I mean to emphasize the underlying compatibility of connectionism and computationalism as regards the notions of cognitive innateness that have been adopted by supporters of each. Secondly, I mean to highlight the usefulness of the notion of innate psychological processes in explaining only the development of God-concepts and, potentially, their universality.

It will be argued below that the mechanism approach to innateness demonstrates how the internal structure of the God-concept could be innately determined, whereas representational nativism provides a theory of how the God-concept is ascribed certain characteristics on the basis of innate ontological knowledge. It will be argued, therefore, that both approaches offer explanations of how the developmental path of the God-concept may be innately constrained, but the origin of the God-concept cannot be said to be strictly innate—from the perspective of cognitive psychology, no literal, heritable *sensus divinitatis* can be discerned here. I will begin with a fuller exposition of the mechanism approach to innateness.

A connectionist perspective on how development is constrained by innate mechanisms

Working from within a resolutely connectionist paradigm, Elman et al., in *Rethinking Innateness*,[17] believe that the key to an adequate account of "where knowledge comes from" is to be found in developmental cognitive neuropsychology. They identify the question at the bottom of the innateness debate as essentially the following:

> ...how to account for those *behaviors* which, given the normal experiences encountered during development, are universal across a species.[18]

Although connectionist networks are usually portrayed as simply reactive and as merely responding to statistical regularities in the environment, Elman et al. believe that there is room within connectionism for the idea that innate constraints on higher cognitive behaviors may be implemented at the sub-representational level.[19] Thus, they suppose, there is no need to posit the existence of innate representational content, as has traditionally been the norm in theories of cognitive development.

Elman et al. suggest that since development is a multi-leveled process—which occurs as a result of interactions occurring within and/or between a number of different levels, from the genetic, and intracellular levels all the way through to the highest levels of biological and mental organization—the notion of cognitive innateness must also be considered at different levels of analysis. The bottom line is that if a particular concept, structure, process, etc., can be said to be innately determined, then its development must be constrained at one or more of these levels. Innateness is assumed to be a feature only of the mechanisms that constrain cognitive development. They hypothesize three possible levels at which constraints might act—the representational, the sub-representational, and the chronotopic (developmental timing) levels. So, effectively, the question that Elman et al. ask can be summarized as follows: Is cognitive development (in connectionist networks) constrained by (1) the existence of "hard-wired" representations, (2) by the fact that the structure of the brain encourages certain ways of organizing information over others, or (3) by virtue of there being a genetically determined "schedule" of maturation?

Cognition, computationalists argue, is basically the formal manipulation of symbolic representations in the manner of a computer, whereas connectionists argue that cognition consists in the patterns of activity that occur across networks of neurons that operate in parallel and are distributed throughout the brain.

Representational constraints

As was mentioned above, Elman et al. dismiss the likelihood of the existence of innate representational content and, therefore, the possibility of cognitive constraints acting at the representational level. They base their argument on the idea that, in a connectionist network, the innate capacity to form specific types of representations can be modeled by prespecifying weights between nodal connections. In neuronal terms the equivalent would be the corresponding "weightings" of specific cortical microcircuitry to encourage the production of specific patterns of synaptic activity, but there is no evidence of this occurring in the human brain. Rather, the cortex exhibits remarkable plasticity into adulthood (considerably more will be said about this below).

The apparent failure to find prespecified patterns of cortical activity is not necessarily adequate grounds for dismissing the possibility of innate representational contents, even in connectionist models of mind, and Elman et al. admit as much. Fodor notes:

> Assuming (what's far from obvious...) that connectionist networks can represent cognitive content at all, they can perfectly well represent innate cognitive content inter alia.[20]

In fact, there may well be other levels of neural organization, both higher and lower than the cortical level, which may support innate representational content. This possibility remains currently unexplored; so whereas Elman et al. are forced to admit the possibility of innate representational content, they believe this to be a rare, perhaps even chimerical phenomenon.

Sub-representational constraints

Instead, Elman et al. prefer to locate innate cognitive constraints at the sub-representational level. They propose that development can be constrained at three different neural levels: (1) the micro-level, due to the specific properties of neurons, (2) the local level, due to the structure of specific brain regions (for example, the number of cortical layers, types of neurons, etc.), and (3) the global or "macro-level," due to connections between entire brain regions. Elman et al. describe the general idea as the proposition:

> The overall structure of the network constrains or determines the kinds of information that can be received, and hence the kinds of problems that can be solved and the kinds of representations that can subsequently be stored. In other words, the macrocircuitry—meaning principally the areal patterns of input/ output mappings—may be prespecified even if the microcircuitry is not.[21]

So, to return to current concerns, what are the implications for the origin of the God-concept of there being cognitive developmental constraints at the sub-representational level? If innateness concerns only constraining mechanisms then, obviously, the origin of the God-concept cannot be considered to be innate. If the connectionists are right, then the representation of God is acquired through experience of the world; but are there any other, perhaps more mundane, implications of innate architectural constraints on the formation of the God-concept? This question ultimately concerns the innate structure that may be imposed upon representations and is best answered in the terms of an increasingly popular cognitive framework-schema theory.

To date, theories that posit the existence of mental "schemata" are the most researched and well developed explanations of the organization of knowledge. Arbib and Hesse[22] refer to schemata as the basic units of representation of a person's world, and other such vague definitions are common, given the diffuseness of the concept. Schemata are alleged to be well-structured networks of information, the relationships between which are developed through experience of the world. Schemata may exist for everything from the concept of a pencil, which incorporates the sub-concepts of pencil-lead and wood and notions of sharpness, to the process of booking a holiday, to the concept of God. How the concepts of each schema relate to one another depends on the specific context in which they were experienced and how they are subsequently employed. Eysenck and Keane[23] point to the very loose definition of schemata, given their tendency to take on different structures, depending on the kind of knowledge they are representing, be it events, objects, relations, etc.

Generally speaking, then, they provide a means of relating specific concepts to each other through the organization of generic categories of knowledge. Connectionist schemata differ from the traditional computationalist conception of schemata in several important ways. Crucially, representations are no longer seen as the "values" in a network of nodes, but rather as distributed patterns of interaction among connected units, which are themselves alleged to correspond (somehow) to neurons or to clusters of neurons. Thus, schemata are portrayed as the very processes of mental organization themselves, rather than the collection of information that makes up a specific concept. As such, they are knowledge systems that are allegedly grounded firmly in the neurological substrate, and that mediate experience of the world. According to the mechanism approach, these processes are also innate.

This idea is useful in specifying how different aspects of the representation of God are organized in a relational structure and embedded in experience, but also in explaining how the development of the God-concept must be innately constrained. Developmental constraints must act so as to ensure that the acquisition of novel information regarding the God-concept is integrated with extant knowledge in a way that is consistent with one's ongoing experience of the world. The existence of such developmental constraints may partially explain the observed similarities between the God-concepts of very young children, such as those observed by Fowler and Goldman.[24] After all, given a similar experience of reality and an innately constrained way of structuring that experience, this is precisely what one would expect. Below, this idea will be elaborated upon further through a discussion of Pascal Boyer's work in this field. For now it will suffice to say that positing the existence of innate representational mechanisms does not necessarily support the idea that the God-concept is innate, nor does it throw any light on how a concept might come to be a universal feature of human culture. It may, however, support the idea that the general developmental pattern of the God-concept may be innately constrained.

Chronotopic constraints

Other possible innate constraints on the development of higher cognitive behaviors have been attributed to the specific timing of "stages" in the developmental process. These are referred to as "chronotopic constraints."[25] That such constraints may have significant effects on development has frequently been demonstrated in connectionist networks, and in computational models of mind. At the level of the brain it has been demonstrated, for example, that specific regions of cortex may become specialized for a specific task purely on the basis that they were "ready at the right time."[26] Although, to date, the developmental details remain sparse, this effect has been implicated in the left-hemisphere specialization for language. From a computational perspective, Leslie has argued that the mechanism for the emergence of the child's capacity to employ a theory of mind may be constrained by innate chronotopic factors. His argument is that the requisite "meta-representational" capacity "matures" at around 18 months. Such innate maturational factors are almost certainly responsible for the emergence of secondary sexual characteristics in humans, so why should a similar process not be implicated in psychological development?

It seems likely that as certain mental capacities develop, so the mental representation of God also changes. Goldman has suggested, for example, on the strength of the Piagetian developmental framework, that the God-concept changes from anthropomorphic to abstract over the course of development.[27] Although the cognitive-stage theories of religious development that were proposed by Fowler and Goldman have been largely discredited, there is still evidence to suggest that the God-concept employed by children is significantly different from that employed by adults, perhaps as a by-product of the clarification of the distinction between "fantastical" and "realistic" thinking.[28] All things considered, it seems likely that that innate chronotopic constraints are important determinants of the development of the representational capacity in general and, so, of the concept of God.

It appears that exploring the idea that innate cognitive mechanisms may constrain the development of the God-concept is both sensible and informative in some manner, though perhaps a trivial one. Even if one denies the possibility of constraints at the representational level, innate developmental constraints at the sub-representational level can inform theories of how the component features of the God-representation are organized within a neurally instantiated framework. The coherence of the concept can also be accounted for; and most useful of all, arguably, are the possibilities that exist for the elaboration of a model in which features of the God-representation can be seen to be both interrelated and related to other schematized information.

Unfortunately, even if one is to accept a connectionist model of cognitive architecture (and it is by no means certain that it is accurate[29]), what the mechanism approach adds to a discussion of the innateness of the God-concept specifically is negligible. It suggests that the development of the God-concept may be partially innately prescribed as a result of constraints on its structure and the mental organization of related knowledge. This is certainly interesting, but it supports the idea that it is wrong to use the word "innateness" in relation to the God-concept, given that this term is interpreted here as referring to what arises as a result of interactions that are "internal to the organism." Indeed, the mechanism approach depends upon an individual's exposure to religion in order to account for the acquisition of the concept of God. So, is there any stronger way in which the concept of God might be considered to be innate? This would entail a form of representational nativism, which is the subject of the next section, in which I address the possibility that the God-concept is partially constituted by innate representational, as well as culturally acquired, knowledge.

Representational nativism

Fodor, Hinde, Boyer, Barrett, Keil and Leslie (to name but a few) all subscribe to a computationalist model of mind and argue that cognitive innateness subsists in the form of the actual content of mental representations that are assumed to subserve higher level cognitive functions.[30] According to this view, children are born with some content-specific mental representations that are elaborated upon as a result of experience or that are somehow "triggered" during maturation. These representations—which may even act as precursors or forerunners of adult mental capacities—allegedly constrain sensory perception and the acquisition and representation of theoretical knowledge subsequently perceived in relation to them.

Boyer's theory and others explicitly deny the existence of an innate "God-module" and offer alternative explanations for the construction of the God-concept that implicate the same domains of knowledge and the same mental processes that are involved in the formation of other concepts.

Those who advocate a representational nativism have produced a substantial corpus of experimental literature, and instances of potentially "innate knowledge" are easy to find. Before proceeding with an example of how a theory of representational nativism might elucidate the formation of the God-concept, however, it is necessary to highlight a few features of the classical (Fodorian) information processing model that are especially pertinent to the current discussion. It will be argued that the mechanism approach is not incompatible with representational nativism, and that connectionist criticisms are not as damning of it as some have presumed.

Supporters of information-processing models allege that the brain exhibits a "modular" structure. That is to say, it is structured in such a way that the work of information-processing is divided between different areas of the brain. Among the characteristic properties of modules are the requirements that: (1) they are encapsulated—the flow of information within and between modules, and between unmodularized mental systems is constrained by cognitive architecture; (2) they exhibit ontogenetic universals—modules develop according to a characteristic developmental sequence; they are localized and domain specific—each module is concerned with dedicated neural structures that perform operations upon one and only one specific type of information, for example, information relevant to face recognition, or language learning; (3) they are innate—"the information and operations proprietary to a module are more or less exhaustively 'genetically preprogrammed' (whatever, exactly, that means)."[31] Modules are to be seen as distinct from representations but as acting so as to process information concerning specific categories of representations. In the Fodorian model, then, both representational contents and cognitive mechanisms can be innately determined.

So, what are the objections to the idea of innate representational content? It is important to realize, as Fodor does, and as even Elman et al. acknowledge, that the existence of developmental constraints at the cognitive architectural level does not preclude the possibility of domain specificity, the existence of innate representational content, nor the possibility that developmental constraints operate at that level. They are wholly compatible. Furthermore, many who reject connectionism as an adequate theory of cognitive representation accept it as a viable model at the implementational level, and would be happy to accept that the innate neuronal structure of the brain must somehow affect its processing capacity. Nevertheless, supporters of connectionist models of cognitive architecture engage in two major lines of argument against the plausibility of innate representational content.

Firstly, they suggest that, since the principles of modularity and domain-specificity are foundational to representational nativism, observations of cortical plasticity make innate representational content an unlikely prospect. After all, they argue, if experiments can show that a specific area of the cortex—the supposed seat of representational encoding—can host a variety of different types of representations, depending on non-genetically encoded developmental factors, then it seems ridiculous to suppose that a particular representation could be innately "hard-wired" to be anywhere specific. However, it seems that studies investigating neural plasticity have been restricted to (quite often unsuccessful) demonstrations of cortical equipotentiality, mainly as regards the primary sensory cortices of non-human vertebrates.[32] Even if these results could be partially generalized to humans—and it is by no means certain that they can—there is little reason to suppose that cortical regions governing higher cognitive capacities in humans are anywhere nearly as plastic.[33] Fodor asserts:

> [N]obody knows what the neural plasticity of the infant's brains means. Nobody has any idea, for example, whether the infant's brain is plastic in respects that affect cognitive architecture.[34]

Secondly, opponents of representational nativism argue that the apparent developmentally constraining effects of innate representational content can actually be readily explained as the effects of innate representational mechanisms. To these ends, Elman et al. choose some of the classic examples of capacities that have been supposed to depend upon innate representations—such as the child's sensitivity to faces, speech and language, the child's "intuitive" ontological assumptions regarding the physical world, and the capacity to infer object permanence—and attempt to redescribe experimental findings from a connectionist perspective.[35] These capacities are ultimately described as "emergent forms," in the sense that they (mysteriously) naturally emerge from certain recurrent patterns of activity in neural networks. They do meet with some limited success, but then so have theories that have implicated innate representational contents. Once again, Fodor objects:

> If representational innateness is often the obvious theory of a creature's mental capacity, why not suppose, at least some of the time, that that's because it's the right explanation of the creature's mental capacity?[36]

Even if there is some truth to representational nativism, what are the implications for theorizing about the concept of God? Could there perhaps be an innate precursor to the God-concept that develops over time through exposure to a specific culture? The following section addresses this issue through an exposition of Boyer's theory of "the naturalness of religious ideas,"[37] and draws together the strands of the argument so far. It will be argued that Boyer presents good grounds for dismissing the idea that the God-concept is innately determined in any meaningful way, but further discussion of representational nativism will add extra weight to the argument that innate psychological capacities constrain its structure and development.

The naturalness of the God-concept

Theories of innate representational content have enjoyed a high profile in cognitive psychological models of the transmission and acquisition of a variety of religious concepts, including the God-concept.[38] Both Pascal Boyer and Stewart Guthrie explicitly offer explanations of how some religious concepts come to be universally evident. I shall concentrate on Boyer's contribution, which has proved to be among the most influential in all the cognitive study of religion.

Boyer's starting point is the acknowledgement of the widespread opinion that there is no "cognitive domain" of religious symbolism, and no cognitive discontinuity between (so-called) religious cognition, reasoning about religion, and reasoning about secular life.[39] He also observes that religious representations are possessed of certain features that are found to be recurrent in very diverse cultures, and that at least some of the elements of religious concepts—such as those concerning the existence and agency of supernatural beings, for example—do not appear to be culturally transmitted. In the process of attempting to explain this cultural underdetermination, and the diachronic and synchronic resilience of some concepts, Boyer has developed the concepts of intuitive and counter-intuitive ontologies.

By "intuitive ontologies" he means those systems of beliefs that enable "the spontaneous assumptions humans entertain about ontological categories,"[40] and that require no cultural medium of transmission. It is these intuitive ontologies that are alleged to have innately specified content. By "counter-intuitive ontologies" he means those systems of belief that contain certain elements that seem explicitly to contradict intuitive beliefs. Boyer is certainly not alone in making such assumptions and has apparently been supported by a good deal of empirical psychological research.[41]

Keil's classic investigation[42] of the evolution of ontological distinctions in young children supported Sommers' hypothesis that the restricted number of appropriate predicates that a specific term relating to a specific concept might take on implies that concepts can often be placed, on the basis of very little information, firmly within a certain ontological category, such as sentient being, artifact, event, vegetable, etc.[43] An ontological distinction between such objects as "living species" or "artifacts," and contingently between the descriptive terms appropriate for each, was made by the children purely on the basis of their description as being "sleepy" or "fixed," even when the objects in question were purely fictional and, therefore, completely novel. Keil's experimental results have since been supported by numerous other investigations,[44] and such findings are often used to support the notion of innate representational content.

As regards the cognitive anthropological study of religious concepts, the three most important areas of research concern the intricacies of children's intuitive notions of agency,[45] and animism,[46] and their (arguably) innate capacity to form and employ a relatively complex "theory of mind."[47] Barrett and Keil argue that the relevance of these studies for the potential innateness of God-concepts lies in their implications for an explanation of how a limited range of properties come to be ascribed to God.[48]

What is proposed is that certain features of innate representations, coupled with a domain-specific information-processing capacity and innate sub-representational developmental constraints, restrict the types of God-concepts that people are able to form. For example, the perception of God as having agency in the physical world encourages the interpretation of divine actions against a background of intentionality, beliefs and desires. Thus, God is conceptualized as a living-kind first and foremost, and through the schematization of this information, other information becomes associated with the concept of God. If God is accredited with intentional mental states, innate attributional processes require that a variety of other mental characteristics be also imparted. God could possibly be ascribed intentional mental characteristics, such as "perceiving" or "knowledgeable," for example, as well as human affective states such as "angry" or "loving." All this may potentially be inferred as a direct consequence of perceptions of God's agency.

Describing the formation or acquisition of the God-concept as a primal behavior is likely to be the most it is possible to say about the innateness of its origins. From a neuropsychological developmental perspective, no innate representation that could be said to correspond to the God-concept appears to exist.

Boyer endorses the widespread opinion that there is no "cognitive domain" of religious symbolism, and no cognitive discontinuity between (so-called) religious cognition, reasoning about religion, and reasoning about secular life. It differs from connectionist schema theory by supposing that there is no organizational level beneath the symbolic representational level at which relationships between information can be modeled. In computationalist schemata, then, specific concepts or even sub-schemata take the forms of values that fill "slots" in chains or networks of information. Relations between the slots can take many forms, such as *X* hit *Y*, or *X* caused *Y*; and assumptions characteristic of a specific concept must be integrated to the extent that each assumption helps to render other conceptual assumptions intelligible. Boyer refers to conceptual assumptions that are "linked by causal connections" as a "causal nexus"; and he asserts that the causal relationships between these assumptions contribute to the cohesiveness of a concept.[49] The characteristics ascribed to God on the basis of natural ontological assumptions may constitute just such an innate causal nexus, which can then be fleshed out through an individual's experience of the world and the formal learning of a religious tradition.

There are contingent benefits of this theory, such as an explanation of why God is unlikely to be imputed with the characteristics of, for example, a stone or running water—such entities are just not "naturally" perceived to have agency in the world, and their representations are not schematically connected to those representations that are characteristically part of agent concepts. It therefore accounts for the limited range of extant God-concepts, despite there being a potentially infinite variety of potential interpretations of any given experience, even among those who share an immediate environment.

So, Boyer's computationalist theory of the formation of God-concepts is able to account for how they acquire some of their distinctive characteristics. Once again, no claims regarding an innately determined representation of God are made. In fact, Boyer makes exactly the opposite claim. The causal nexus is not alleged to provide an exhaustive account of conceptual structure, since it fails to account for some of the peripheral information a person holds about specific objects and the conceptual category to which they belong. The God-concept will also come to incorporate assumptions that are not part of that causal nexus—such as "God deplores violence," or "God is infinite, omnipresent and omniscient." Boyer argues that these assumptions are comprised of auxiliary knowledge[50] that is acquired through purely cultural mediums—Christian doctrine for example.[51]

But what of the idea that there may be an innate "precursor" to the God-concept, a precoursor that is subsequently elaborated upon? Theoretically, this remains a possibility, but there is no evidence at all that this is the case. Actually, Boyer's theory and others explicitly deny the existence of an innate "God-module," and offer alternative explanations for the construction of the God-concept that implicate the same domains of knowledge and the same mental processes that are involved in the formation of other concepts.[52] There is, therefore, no need to postulate the existence of an innate precursor to the God-concept to explain its cultural underdetermination. As with the mechanism approach, it seems that the only innate features of the God-concept that representational nativism can explicate are those that are common to other kinds of concept, namely innately determined constraints on aspects of development.

Both the mechanism approach and theories of representational nativism shed some light on how innate psychological mechanisms may come to bear on the development and structure of the God-concept, but not on its origin.

To summarize, then, both the mechanism approach and theories of representational nativism shed some light on how innate psychological mechanisms may come to bear on the development and structure of the God-concept, but not on its origin. Interaction with the environment seems essential for its initial formation or acquisition. Consideration of the representation of God at the subpersonal cognitive psychological level leads to the conclusion that it can be considered to be innate only in three very trivial, almost vacuous, senses: firstly, as with all concepts, it is structured in a way determined by innate cognitive architectural constraints; secondly, as with all other concepts, the particular characteristics it can assume are constrained by intuitive ontological assumptions regarding basic categories of existence; and thirdly, as with many other concepts, its development continues in tandem with other concepts and capacities that may mature according to an innately predetermined pattern.

This is not to say that these observations are not interesting. To the contrary, I believe that the contribution of cognitive psychology to the study of religion is invaluable precisely because of these observations—the idea that the development of the God-concept is constrained by universal cognitive features has provided a new impetus to the study of religion, and may eventually prove to be of unrivalled importance for the psychology of religion. I am merely arguing that these observations do not add up to "innateness," as it is traditionally conceived. The developmental process may be innately constrained, but this is very different to the claim that the God-concept itself is innate.

However, if the development of the God-concept can be considered to be an innately constrained process, then perhaps the notion of innateness still has a role to play in explicating the origin of the God-concept. As a final thought, I shall briefly consider the idea that the God-concept is a product of innately determined psychological processes and fundamental, universal features of an individual's environment.

Primal behaviors and the God-concept

It is certainly not the case that because a particular concept, capacity, behavior, etc., appears to be universally evident in a particular population that it should automatically be presumed to be innate. Indeed, Johnson and Morton[53] have drawn an important distinction between those cognitive phenomena that are products solely of intrapersonal interactions, and those phenomena that, though universal, are products of interactions with aspects of the environment that are common to all members of the species. This latter category of cognitive phenomena is referred to as "primal."

Describing the formation or acquisition of the God-concept as a primal behavior is likely to be the most it is possible to say about the innateness of its origins. From a neuropsychological developmental perspective, no innate representation that could be said to correspond to the God-concept appears to exist. Quite to the contrary, cognitive anthropological models such as Boyer's are primarily concerned with demonstrating that the core schematized content of the God-concept depends upon and can be explained by the prior experience of an everyday reality. Only through experience of natural phenomena can the God-concept acquire its distinctive characteristics, though aspects of its structure and development may depend upon innate cognitive constraints.

There is a psychological tradition of viewing the origin of the God-concept in terms of primal behavior that extends from psychoanalytic to cognitive anthropological theory. The most famous expositor of this type of theory in modern times is Ana-Maria Rizzuto who, in her psychoanalytic object-relations theory of the Birth of the Living God, proposed that the God-representation develops as an essential element in early cognitive development. These theories do not consider the formation and development of the God-concept to be innate so much as inevitable—a product of the human condition like so many other aspects of social and perceptual reality, but not necessarily a purely intrapersonal psychological creation.

A good example of such a theory in cognitive psychological terms is that of Stewart Guthrie, who argues that the human tendency to anthropomorphize nature leads, ultimately, to the inference that the world is populated by invisible supernatural beings.[54] Guthrie argues that the anthropomorphic tendency is rooted in evolutionary theory and originally would have bestowed a selective advantage on the bearer, as a result of their concomitant hypervigilance. In the modern world, he argues, this innate perceptual bias may have led to the development of complex religious systems, but the tendency to anthropomorphize reality persists. Though he does not use the term himself, the original formation of the God-concept and the propensity to intuit the existence of God can be understood in these accounts as a primal behavior—the product of an interaction between an innate perceptual bias and a stimulating environment that was common to all members of the species. My aim here is not to defend Guthrie's theory, merely to illustrate a potentially fruitful avenue of future research into the universality of religious concepts.

Concluding thoughts

Through an analysis of the cognitive psychological definitions and theories of innateness, the origin of the God-concept has been shown to be, in some form, dependent on environmental experience. Whether one endorses a connectionist or a computationalist model of cognitive architecture, or a representational nativist or mechanism approach to psychological innateness, there is no good reason to suppose that the God-concept, or a precursor to it, originates as a result solely of internal interactions. Whereas aspects of its structure and development may be said to be innately constrained, it cannot be said to be an innate representation in any non-vacuous or interesting way. So, from the perspective of cognitive psychology at least, the historically popular attempt to ground knowledge of God in an intuitive or archetypal God-concept appears misguided. There may well be a natural, heritable *semen religionis* or *sensus divinitatis*—and future possibilities for research lie in the continued exploration of this possibility—but it is unlikely that an innate concept of God fulfills either of these roles.

As regards an adequate psychological theory of the universality of the God-concept, cognitive psychology alone is unlikely to provide it. The best hope for such a theory lies in the research of so-called primal behaviors, and the attempt to make a firm connection between psychological dispositions, innate or otherwise, and elements of the environment that are common to all members of the human species. Boyer and others have shown how cognitive psychology may offer a new way partially to explain the recurrence, perhaps even the pan-cultural appeal of religious concepts, but innateness is too strong a claim. It seems that the formation of God-concepts may be an inevitable feature of human cognitive development, but further cross-cultural empirical research in this area is essential to validate this assertion properly. A fuller explanation presents methodological as well as theoretical challenges, but the critical examination of old or misapplied concepts, such as has been attempted in this essay, and the willingness to integrate theories to create a genuinely interdisciplinary approach can only drive the study of religion forward.

Works cited:

Arbib, M. A., and M. B. Hesse. *The Construction Of Reality*. Cambridge: Cambridge University Press, 1986.

Atran, S. "Core domains versus scientific theories: Evidence from systematics and Itza-Maya folkbiology." In *Mapping the Mind: Domain Specificity in Cognition and Culture*, ed. by L. A. Hirschfeld and S. A. Gelman, 316-41. Cambridge: Cambridge University Press, 1994.

Barrett, J. L., and F. C. Keil. "Conceptualizing a nonnatural entity: Anthropomorphism in God concepts." *Cognitive Psychology* 31, no. 3 (1996): 219-47.

Beckermann, A., H. Flohr, and J. Kim, eds. *Emergence or Reduction? Essays on the Prospects of Nonreductive Physicalism*. Berlin: de Gruyter, 1992.

Boyer, P., ed. *Cognitive Aspects of Religious Symbolism*. Cambridge: Cambridge University Press, 1992.

_____. *The Naturalness of Religious Ideas*. Berkeley: University of California Press, 1994.

_____. "Further Distinctions between Magic, Reality, Religion, and Fiction." *Child Development* 68, no. 6 (1997): 1012-14.

Brown, L. B. *The Psychology of Religious Belief*. London: Academic Press, 1987.

Burkert, W. *Creation of the Sacred. Tracks of biology in early religions*. Cambridge, Mass.: Harvard University Press, 1998.

Carey, S., and E. Spelke. "Domain-specific knowledge and conceptual change." In *Mapping the Mind: Domain Specificity in Cognition and Culture*, ed. by L. A. Hirschfeld and S. A. Gelman, 169-201. Cambridge: Cambridge University Press, 1994.

Chandler, M. "Rescuing Magical Thinking from the Jaws of Social Determinism." *Child Development* 68, no. 6 (1997): 1021-23.

Clifford, J. "Introduction: Partial Truths." In *Writing Culture: The Poetics and Politics of Ethnography*, ed. by J. Clifford and G. Marcus, 1-26. Berkeley: University of California Press, 1986.

_____. *The Predicament of Culture: Twentieth-Century Ethnography, Literature and Art*. Cambridge, Mass.: Harvard University Press, 1988.

Colby, K. M., and R. J. Stoller. *Cognitive Science and Psychoanalysis*. Hillsdale, N.J.: Lawrence Erlbaum Associates, 1988.

Durkheim, E. *The Elementary Forms of the Religious Life*. London: Allen & Unwin, 1964.

Elman, J. L., E. A. Bates, M. H. Johnson, A. Karmiloff-Smith, D. Parisi, and K. Plunkett. *Rethinking Innateness: A Connectionist Perspective on Development*. Cambridge, Mass.: MIT Press, 1996.

Eysenck, M. W., and M. T. Keane. *Cognitive Psychology: A Student's Handbook*. Hove, England: Lawrence Erlbaum Associates, 1990.

Fodor, J. A. "The current state of the innateness controversy." In *Representations*, ed. by J. A. Fodor, 257-317. Cambridge, Mass.: MIT Press, 1981.

_____ and Z. Pylyshyn. "Connectionism and cognitive architecture: a critical review." *Cognition* 28 (1998): 3-71.

_____. *In Critical Condition: Polemical Essays on Cognitive Science and the Philosophy of Mind*. Cambridge, Mass.: MIT Press, 1998.

Freud, S. *The Future of an Illusion*. London: Hogarth Press, 1978.

Goldman, R. *Religious Thinking from Childhood to Adolescence*. London: Routledge & Kegan Paul, 1964.

Gopnik, A., and H. M. Wellman. "The theory theory." In *Mapping the Mind: Domain Specificity in Cognition and Culture*, ed. by L. A. Hirschfeld and S. A. Gelman, 257-94. Cambridge: Cambridge University Press, 1994.

Guthrie, E. S. "A Cognitive Theory of Religion." *Current Anthropology* 21, no. 2 (1980): 181-283.

_____. *Faces in the Clouds*. New York: Oxford University Press, 1993.

Hinde, R. A. *Biological Bases of Human Social Behaviour*. New York: McGraw-Hill, 1974.

_____. *Relationships: A Dialectical Perspective*. Hove, England: Psychology Press, 1997.

_____. *Why Gods Persist: A Scientific Approach to Religion*. London: Routledge, 1999.

Hirschfeld, L. A. "Is the acquisition of social categories based on domain-specific compeence or on knowledge transfer?" In *Mapping the Mind: Domain Specificity in Cognition and Culture*, ed. by L. A. Hirschfeld and S. A. Gelman, 201-34. Cambridge: Cambridge University Press, 1994.

Hood, R. W., B. Spilka, B. Hunsberger and R. Gorsuch. *The Psychology of Religion: An Empirical Approach*. 2nd ed. New York: Guilford Press, 1996.

Idinopulos, T. A., and E. A. Yonan, eds. *Religion and Reductionism: Essays on Eliade, Segal, and the Challenge of the Social Sciences for the Study of Religion*. New York: E. J. Brill, 1994.

James, W. *The Varieties of Religious Experience*. London: Fontana, 1971.

Johnson, M. H. *The Biology of Change*. Oxford: Blackwell, 1997.

_____ and J. Morton *Biology and Cognitive Development: The Case of Face Recognition*. Oxford: Blackwell, 1991.

Keil, F. C. *Semantic and Conceptual Development*. Cambridge, Mass.: Harvard University Press, 1979.

Leslie, A. M. "Pretense and representation: the origins of 'theory of mind.'" *Psychological Review* 94 (1987): 412-26.

_____. "ToMM, ToBY, and agency: core architecture and domain specificity." In *Mapping the Mind: Domain Specificity in Cognition and Culture*, ed. by L. A. Hirschfeld and S. A. Gelman, 119-49. Cambridge: Cambridge University Press, 1994.

Martin, M., and L. C. McIntyre, eds. *Readings in the Philosophy of Social Science*. Cambridge, Mass.: MIT Press, 1994.

McGrath, A. E. *Christian Theology: An Introduction.* 2nd edn. Oxford: Blackwell. 1998.

Mithen, S. *The Prehistory of the Mind: A Search for the Origins of Art, Religion and Science.* London: Thames & Hudson, 1996.

Morris, B. *Anthropological Studies of Religion.* Cambridge: Cambridge University Press, 1996.

Piaget, J. *The Construction of Reality in the Child.* New York: Ballantine Books, 1954.

Premack, D., and A. J. Premack. "Moral belief: Form versus content." In *Mapping the Mind: Domain Specificity in Cognition and Culture*, ed. by L. A. Hirschfeld and S. A. Gelman, 149-69. Cambridge: Cambridge University Press, 1994.

Rappaport, R. A. "The sacred in human evolution." *Annual Review of Ecology and Systematics* 2 (1971): 23-44.

Rizzuto, A. M. *The Birth of the Living God.* Chicago: University of Chicago Press, 1979.

Segal, R. A. *Religion and the Social Sciences: Essays on the Confrontation.* Atlanta: Scholars Press, 1989.

_____. *Explaining and Interpreting Religion: Essays on the Issue.* New York: Peter Lang Publishing, 1992.

Slee, N. "Goldman yet again." *British Journal of Religious Education* 11 (1989), 84-93.

Sommers, F. "The ordinary language tree." *Mind* 68 (1959): 160-85.

Stark, R. "Atheism, faith, and the social scientific study of religion." *Journal of Contemporary Religion* 14, no. 1 (1999): 41-62.

Walton, G. E., and T. G. Bower. "Newborns form 'prototypes' in less than 1 minute." *Psychological Science* 4, no. 3 (1993): 203-205.

Watts, F. N., and J. M. G. Williams. *The Psychology of Religious Knowing.* Cambridge: Cambridge University Press, 1994.

Woolley, J. "Thinking about fantasy: are children fundamentally different thinkers and believers from adults?" *Child Development* 68, no. 6 (1997): 991-1011.

Endnotes:

1. See Burkert; Rappaport.

2. It is important to note that throughout this essay the generic term "religion" is distinguished from the specific religions. When a specific religion is the topic of discussion, it is clearly denoted as such.

3. Hinde, *Why Gods Persist*, p. 11.

4. McGrath, p. 531.

5. Throughout this essay, the term "God-concept" should not be presumed to refer to the conception of God promoted by any specific religion. Rather, it is meant to refer to a more general concept, such as Robert Hinde's notion of "beings or entities which are outside normal experience."

6. It is accepted here that there are, and there may always have been, atheists. This does not present a serious challenge to the notion that the God-concept may be innately determined, since it is possible that atheism involves a rejection of an extant God-concept rather than the failure to acquire one in the first place. Indeed, some theorists such as Ana-Maria Rizzuto have proposed that all people—atheists and believers alike—hold a representation of God throughout their lives, though some may attend to it more than others.

7. See Elman et al.; and Johnson.

8. See Hinde, op. cit.; and Burkert.

9. For example, Hinde, *Biological Bases of Human Social Behaviour.*

10. Theories of development are now rarely characterized by the hackneyed and simplistic distinction between "nature" or "nurture." Historically, these terms encouraged the assumption that patterns of developmental change must be entirely attributable to either genetically predetermined factors, or to the influence of the person's environment. Such an extreme disjunction of the organism from its developmental circumstances became increasingly unpopular as understanding of the distal effects of genes increased, and encouraged the perception that the relationship between phenotype and genotype is rarely as

straightforward as Mendel's famous experiments would have us believe.

11. See Elman et al., ch. 1.

12. The classic formulation of a causal epigenetic approach to psychological development was proposed by Piaget. Paradigmatic examples of the probabilistic epigenetic model at the neuropsychological level are provided by studies of linguistic development. The acquisition of language is frequently conceived as a dynamic process that is dependent upon numerous neurophysiologically grounded psychological faculties, and thereby mediated by intrapersonal biological processes, but which is continually modified through the assimilation of new experience.

13. Johnson, p. 8.

14. "Interactions internal to the organism" is elaborated upon as "interactions between the genes and their molecular and cellular environments without recourse to information from outside the organism." Elman et al., p. 22.

15. Fodor, *In Critical Condition*, p. 146.

16. Elman et al., p.xii.

17. Ibid.

18. Ibid.

19. Computationalists agree with connectionists that development is constrained at the cognitive architectural level but disagree with connectionists over what the cognitive architectural level is. Hence, it is confusing to refer, as Elman et al. do, to the "architectural level" of constraint; and in this section, the level at which connectionists suppose cognition to occur will be referred to as the "subrepresentational level" of constraint.

20. Fodor, op. cit., p. 148.

21. Elman et al., p. 30.

22. See Arbib and Hesse.

23. Eysenck and Keane, ch. 8.

24. See Goldman.

25. See Elman et al., ch. 2.

26. See Annett.

27. See Spero for a refutation of this principle. He argues that those forms of religiosity in which the God-representation is purely abstract may be aboriginal or precursor religious phenomena, and that they may reflect some developmental malfunction. Also see Slee (1989) for a stinging critique of Goldman's work.

28. See the review article by Woolley, and the appropriate responses, especially those of Boyer, *Further Distinctions*; and Chandler.

29. A degree of caution is in order. Despite the methodological, and argumentative ingenuity of Elman et al., the problem persists that brains do not necessarily function in exactly the same way as connectionist networks do. As Fodor argues, "There isn't one, not one, instance where it's known what pattern of neural connectivity realizes a certain cognitive content, innate or learned, in either the infant's nervous system of the adult's. To be sure, our brains must somehow register the contents of our mental states. The trouble is: Nobody knows how—by what neurological means—they do so" (Fodor, *In Critical Condition*, p. 145).

30. See Fodor, "Connectionism and cognitive architecture," "The current state of the innateness controversy," and *In Critical Condition*. See also Hinde, *Why Gods Persist*; and Leslie, "Pretense and representation," "ToMM, ToBY, and agency."

31. Fodor, *In Critical Condition*, p. 128. Surely, when Fodor states "more or less exhaustively genetically preprogrammed," he would be happy to admit a role for intrapersonal biological reactions that occur in the normal course of development.

32. See Johnson, ch. 2. Johnson cites studies of rodents in which tissue from the auditory cortex was successfully transplanted into the visual cortex with the result that the transplanted tissue took on, to a degree, the same functions as its new immediate environment, thus demonstrating a degree of neural plasticity. However, Johnson admits that, with rare exceptions, "there is still very little *behavioral* evidence indicating that the transplanted tissue shows the same functional properties that the host region normally does" (p. 57). See also Elman et al., ch. 5.

33. Studies of cortical plasticity in humans tend to be of patients who have incurred massive brain injuries, or on those who have suffered abrupt variations in input from peripheral systems (such as blindness or deafness, etc.) Undoubtedly there are numerous obvious problems with constructing theories about normal cortical development on the strength of observations of abnormality.

34. Fodor, *In Critical Condition*, p. 130.

35. Elman et al., ch. 3. See also Johnson.

36. Fodor, op. cit., p. 147.

37. See Boyer, *Naturalness of Religious Ideas*.

38. See Guthrie, *A Cognitive Theory of Religion*, and *Faces in the Clouds*; Boyer, op. cit.; Atran; Barrett and Keil.

39. See Watts and Williams for a full discussion of this principle. Woolley makes the point that the way children think about fantasy should be clearly distinguished from fantastical thinking, per se. The difference is alleged to be that which exists between the child's assumed knowledge of fantastical beings or objects, and thinking about the world, fantastical or real, in ways that violate their knowledge of real physical principles. This is essentially another process/content distinction, and neither is assumed to be instantiated by unique domain specific cognitive capacities (see Woolley).

40. Boyer, op. cit., p. 91.

41. Some criticisms of representational nativism from the neuropsychological perspective were offered above. However, there is a further and potentially more serious and damaging issue. It stems from methodological criticism of those studies aimed at identifying innate representations that have tended to focus on the abilities of young children who, it is supposed, do not have sufficient experience of the physical world upon which to draw in order to make firm judgments concerning the fundamental natures of things. Most researchers in this area agree that if very young children were shown to possess the ability to make ontological distinctions on the basis of limited information, then there would be strong grounds for the supposition that the mental processes involved were indeed innate, involuntary ways of organizing information about the world. Whereas connectionists can justify the existence of innate architectural constraints on representational development through appeal to computer models, where the amount of information input can be strictly regulated, studies of young children permit no such controls. Even studies of innate representational content in newborn infants often fail to control for learning effects, which, as Walton and Bower have shown, can occur with astonishing speed. More often than not, theorists rely on assumptions such as "could not have been learned" as evidence that a particular capacity is innate; but when all is said and done, there is just no way to be sure. Nevertheless, innate representational content remains a distinct possibility and, as was suggested above, it remains as good an explanation of some mental capacities as any other.

42. See Keil.

43. It was argued by Sommers that because only a limited number of predicates could sensibly be applied to a given term, the mere application of a certain appropriate predicate will constrain the range of other possible predicates that could also be applied. For example, if X can be said to be literally "breathing," then it would not make sense to say that X was literally "made of stone," but X could possibly be said to be "awake," or "thinking."

44. Atran has since argued persuasively that conceptual formation and categorization do depend to a degree on children's' seemingly innate "commonsense" physical, biological, and psychological intuitions. Also see Carey and Spelke; Leslie; Hirschfeld; Premack; and Gopnik and Wellman's respective chapter in Hirschfeld and Gelman.

45. See Lawson.

46. See Guthrie, *A Cognitive Theory of Religion*, and *Faces in the Clouds*.

47. See Leslie, "Pretense and representation," and "ToMM, ToBY, and agency."

48. See Barrett and Keil.

49. Boyer, *The Naturalness of Religious Ideas*, p. 68.

50. Whether or not this is genuine knowledge is a philosophical point beyond the scope of this essay. It will suffice to note that arguments decrying the possibility of knowledge of God traditionally revolve around the rational/irrational basis for accepting such knowledge as true. Given that human knowledge of others is at best believed to be true, the knowledge of one's perceived personal relationship with God, and the mental representation of that knowledge, should be affected by concerns over rationality only to the extent that human-human relationships are.

51. This knowledge may be schematized in its own right, and parts of it may even be internally causally related, but is not and cannot be part of the causal nexus since knowledge of God's ultimate nature is not derived through an innate process governed by natural ontologies.

52. Mithen, for example, in *The Prehistory of the Mind*, proposes that the evolutionary origins of religion lie in the breakdown of the original barriers that existed between mental modules. As the transmission of information between modules became a possibility, he argues, so animals and inanimate objects could be ascribed the mysterious and counter-intuitive properties that are evident in early religions.

53. See Johnson and Morton.

54. See Guthrie, "A Cognitive Theory of Religion," and *Faces in the Clouds*.

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Progress Toward an Unthinkable Consummation: Sin and the Evolution of Human Consciousness

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Michael Polanyi has argued that tacit knowing—the consolidation and integration of earlier achievements from which to launch further advances—plays an essential role in evolution. Tacit knowledge is often transmitted by observation and imitation—what anthropologist René Girard calls mimesis. Girard suggests that this mimetic tendency has had both beneficial and negative effects: violent outbreaks of mimetic rivalry among early hominids necessitated the development of ritual controls, representing the beginning of culture. Beneath all culture, a universal scapegoating mechanism—humankind's "original sin"—remains hidden. Jewish and Christian scriptures present a countervailing cultural force, challenging human beings to develop in directions not dependent on rivalry and violence.

In the image of God?

> Then God said, "Let us make humankind in our image, according to our likeness.... So God created humankind in the divine image, in the image of God were they created, male and female God created them.
>
> (Gen 2:26–27)

Has sin become extinct? As opponents of the theory of evolution increasingly find themselves at the fringes of theological discourse, it is difficult to say what, if anything, remains of that story of the Fall that served theologians so well for so long. Adam, Eve, and the devil have been ceded to the folklorists and psychologists. Evil is confined to the mind and the determinisms of history, or relativized. Without an agreed-upon moral base, who is to say what is "bad" or "good"?

Yet the story of the Fall served an important function, now often overlooked. It existed to safeguard the obstinate belief, shared by Jews and Christians, in the goodness of creation. The temptation to reject the world and material things is never far from the spiritual quest. What better way to explain the scientific evidence—that nature is ruled by disease, corruption, and death—than to say, with Platonism, that God never had anything to do with the making of such a world? Christianity fought hard to reject this option, portraying a good creation enslaved by sin and "groaning" for liberation (Rom 8:22). Human beings bear the very image of God, it says, albeit distorted by sin. In Christ, the renewal of that original goodness is already underway.

With evolution accepted as reality, what becomes of this account? There is no simple answer. But I would like to suggest a starting place: the forbidden tree, the tree of the knowledge of good and evil, from which Eve and Adam ate.

This paper is about sin and the evolution of knowing. It calls upon the work of two modern-day scientists, the chemist and philosopher Michael Polanyi and the anthropologist René Girard, to explore the relationship between consciousness and sin. Anthropology, like all the social sciences, has been criticized by the natural sciences as "fuzzy science." Nevertheless, because it seeks to give a reliable account of human society and culture from its earliest origins, making sense of them from a biological as well as a social, historical, and cultural point of view, there is reason to hope that it could eventually help to bridge the current division between religion and the natural sciences. Girard, for one, has dared to cross that divide. His interest in violence and the sacred leads him to engage the Bible and the Christian proclamation in ways that challenge everyone, of whatever camp, to hear that proclamation anew, and to ask if we are not, after all, part of that Bible story.

Michael Polanyi and the evolution of meaning

> So out of the ground the LORD God formed every animal of the field and every bird of the air, and brought them to the man to see what he would call them; and whatever the man called every living creature, that was its name.
> (Gen 2:19)

Polanyi begins with the basic evolutionary premise that the highest forms of life are traceable to the lowliest beginnings. This is not to say, with neo-Darwinism, that higher levels are ultimately reducible to, or logically explained by, the laws of physics and chemistry—a claim he criticizes as "inadequate" and "fundamentally vague."[1] Polanyi asks how higher levels emerge from lower levels. What causes comprehensive entities with machine-like functions to develop from nonliving matter? Such entities can no more be explained or predicted on the basis of physical chemical laws than Shakespeare's sonnets can be explained or predicted on the basis of grammar and alphabet. Polanyi writes:

> The laws governing the particulars in themselves would never account for the organizing principles of a higher entity which they form. [...] No level can gain control over its own boundary conditions and hence cannot bring into existence a higher level, the operations of which would consist in controlling these boundary conditions.[2,3]

Accidental mutations play a role in evolution, but Polanyi writes:

> I deny that accidental advantages can ever add up to the evolution of a new set of operational principles, as it is not in their nature to do so.[4]

Changes of type that lead to new levels of existence reflect not random chance but drive, an "autonomous thrust of evolutionary ascent"[5] that Polanyi sees as common to all living organisms: a hunger for discovery, a groping after the truth in response to "intimations" that a novel achievement is within reach.

Polanyi envisions the source of this drive as a "phylogenic field," comparable to the morphogenetic field that guides an embryo to maturity. In this field of potentialities, evolutionary achievements are drawn to work toward their own realization, in the same way human beings strain toward the discovery of what is still unknown and beyond reach. Groping toward higher levels is an enterprise common to all life, he argues. Human consciousness is simply the culmination of an evolutionary drive all beings share toward self-realization and awakening. "An innate affinity for making contact with reality moves our thoughts," he writes. A common restlessness drives the protozoan, the chemist, and the religious seeker.

> We may envisage then a cosmic field which called forth all these centres [of living creatures] by offering them a short-lived, limited, hazardous opportunity for making some progress of their own towards an unthinkable consummation. And that is also, I believe, how a Christian is placed when worshipping God.[6]

As the crowning achievement and exemplar of this upward struggle, human consciousness remains dynamic: a work in

Sacrifice ritually repeats the founding murder and reclaims its beneficial effects. The original violence is unleashed, then spent; thereafter what is addressed in ritual is latent violence.

progress. For Polanyi, there is no arriving, only striving. Evolving to new levels is a process of consolidating and integrating earlier achievements to serve as a launching-place for future advances. As this takes place, past discoveries become present "tacit" knowing: that wealth of innate skill and understanding that human persons possess without being aware of it. They know more—much more—than they can tell, Polanyi observes.[7] This pattern, which Polanyi refers to as the "indwelling" of knowledge, is repeated each time a new skill is mastered, the performance of which depends in large part on being able to incorporate earlier achievements without focusing on them. A piano virtuoso attends "from" the skills of manual dexterity, acquired through years of training, "to" the higher level toward which she is striving: the music, which both incorporates and transcends mechanics.

For human beings especially, teachers play a crucial role in what is able to be achieved. What makes human beings so sophisticated is precisely their ability to transmit and receive knowledge—mostly tacit knowledge, Polanyi says—by observation and imitation. Such imitation is based on the trust, present from infancy, that the meaning of what is being imitated, unknown at the time, will become clear later on. One cannot, by definition, know what the next level up will be like: That is beyond one's grasp, and one must trust that teachers and models, those who beckon from above, know something new and important.

Girard: in the beginning, murder and mayhem

> So when the woman saw that the tree was good for food, and that it was a delight to the eyes, and that the tree was to be desired to make one wise, she took of its fruit and ate; and she also gave some to her husband, who was with her, and he ate. [...] The man named his wife Eve, because she was the mother of all the living.
> (Gen 3:6, 20)

Polanyi calls attention to the creative dynamism of creation, culminating in transcendent human beings capable of universal standards and timeless aims. This overcoming of subjective interests by "universal intent," he writes, is a unique event in the history of the cosmos and represents a movement to an entirely new level.

The news is not all good, however. Polanyi was himself keenly aware that human freedom is often exercised in ways that do not promote life; that the capacity for elevation—spiritual, moral, intellectual, and creative—is at the same time the measure of a capacity for harm. The same beings who discovered language, music, and painting also learned, somewhere along the way, to use weapons.

Is a non-human animal capable of sin? Most would say not. At what evolutionary moment, though, does a hominid cease to be an animal and become a culpable human being capable of offending God? Is there such a moment? Physicist and religious philosopher John Polkinghorne speculates that the shift probably took place gradually, although in the familiar story from Genesis, it is "remembered" as one event:

> The Fall is not to be understood as a single disastrous ancestral act from which all our troubles flow. Yet in the course of human evolution there must have been a period of dawning consciousness of the self, accompanied by dawning consciousness of God, in which the former was asserted against the claims of the latter. The consequences of that turning away from the divine presence would find embodiment in resulting cultural and social structures, thereby propagating from generation to generation an influence reinforcing the false assertion of the self of its autonomy. It is even conceivable that this would bring about a genetic bias towards a certain kind of human nature.... In this way one can understand today what is meant by the traditional theological concept of an entail of human sinfulness from which we need deliverance by God's grace.[8]

The work of anthropologist René Girard begins at this point in the story of human evolution—at the transition from hominid to human being—the entry not only into social organization and culture, but into a world of good and evil and the radical new state known as human freedom. Here, where the animal self is transcended, Girard would agree, is the root and source of that "entail of human sinfulness" to which the Bible testifies. Girard would disagree, however, that the original sin was selfishness. For Girard, sin begins with the discovery that one can aim a stone and kill someone.

Throughout most of the natural world, aggression is associated with survival: with hunger, self-defense, and social competition. It serves beneficial functions and is contained by natural limits. Human violence is distinctive in two ways. One is the "overreaction" factor: Human beings are much more prone to aggressive rivalry within their own social group. Human violence is also distinctive in that it tends to intensify out of control—to escalate and spread, often with catastrophic consequences. This behavior is especially striking when one considers that the closest related species are all, as Girard points out, "peaceable omnivores." What happened? Why are human beings different? Girard says that it came about by chance.

During the process of hominization our ancestors very rapidly became carnivores and hunters. Strong discharges of adrenaline are necessary at the critical moment of the hunt. Such discharges can also occur under different conditions, as in the middle of a family group, for example, under the effect of any sort of disturbance.[9]

Adrenaline release is very useful and also very dangerous, often taking the form of extreme rage. Denied outlets, Girard writes, this rage "tends to turn toward those who are closest and most cherished."[10] One can readily imagine the havoc this would wreak in human communities unless some means could be found for keeping rage under control.

The threat is compounded by the human propensity for turning objects into tools. Among most species, violent rivalry is rarely fatal, because fighting leads to injury. It is difficult to bite, slash, or gore an opponent without being bitten, slashed, or gored in return. Once weapons are introduced into conflict, natural controls are eliminated. Suddenly it is all too easy to inflict fatal injuries. Among hominids, fights may well have become fights to the death before there were any social controls in place to prevent this from happening.

Equally problematic is the human mimetic, or imitative, capacity alluded to earlier. This capacity, present in many species but highly developed in the human, makes the human brain "a kind of mimetic machine," according to Girard.[11] Human behavior is learned by imitation, he writes; it is the agent not only of language but of all cultural transmission. This mimetic propensity, which takes the place of "programmed" behavior, probably developed in a series of evolutionary steps, during which infancy was gradually extended, allowing for greater brain growth.

Once scapegoating was introduced, however, it quickly turned into the defining reality beyond which it is difficult or impossible to perceive alternatives. This insight is the reason why, from a religious perspective, revelation is so crucial for human moral development.

According to Girard, violence probably played a crucial role in this process. Mimesis is an effective vehicle for transmitting learned behaviors, enabling hominids to make the best use of their enlarged brains. It has a drawback, however, in that it tends to promote rivalry and aggression by focusing contagiously on desire: "A" wants what "B" has because it belongs to "B." The story of the forbidden tree in Genesis, Girard says, is really about this universal human predicament. The story begins with mimetic envy and covetousness; it ends with accusations, recriminations, and expulsion.

The combination of all these factors—volatility, mimetic rivalry, and use of weapons—often must have led to disequilibrium. Before the advent of culture, according to Gil Bailie, one hominid's "acquisitive gesture" could easily trigger a mimetic chain reaction among the others:

> By its very nature mimetic desire is extremely fickle. It moves from one object to another as model-rivals designate these objects as desirable. Mimetic desires are contagious, and as they contaminate the social order, they lead to rivalry and violence. At each stage of this deepening crisis, the mimetic passions grow more volatile, more violent, and more responsive to suggestion.
>
> All of this begins with an *acquisitive gesture* toward an object that awakens other desires for that object. A number of acquisitive gestures made toward the same desired object set the conflict in motion.[12]

Among primitive societies, the result might be a catastrophic crisis, a mêlée. But just such violent mimetic crises may also have provided the impetus for their opposite, for culture and social organization, as communities sought ways to prevent further outbreaks.

The scapegoat mechanism

> And when they were out in the field, Cain rose up against his brother Abel and killed him.
>
> (Gen 4:8)

Mimesis sets off the crisis, and mimesis halts the crisis. According to Girardian theory, it halts the crisis by channeling the aggressions of the group toward one individual.

> At the supreme moment of violent disintegration, another gesture is mimetically replicated with even more speed and ferocity than the numerous acquisitive gestures with which the crisis got under way. At the moment when the social frenzy is at its height, someone designates a rival with a startling *accusatory gesture* that has, under the circumstances, an extremely intense mimetic effect. The mêlée becomes a lynch mob.[13]

Whereas the initial acquisitive gesture led to conflict, the accusatory gesture has the opposite effect: It leads to social solidarity. Bailie writes:

> This is the turning point, one that can be accounted for purely in terms of the mimetic forces that are most likely to have been in play in proto-cultural situations.[14]

At the height of the mimetic frenzy, the singled-out individual is murdered by the mob. "The social free-for-all" turns into a "communal exorcism," as the crowd's adrenaline-fueled fury is displaced onto its victim,[15] and in that moment, conflict is transformed into unanimity. The retributive cycle is halted. How did it happen? All participated; all are equally mystified. For the community, the sudden resolution of the mimetic crisis only confirms that the victim was responsible for it. The victim was guilty and is a savior. The victim is promptly mythologized as a god, the lynching (and its beneficial effects) memorialized in ritual. In a strange sequence of events, the fury of the mob becomes the basis for a new social order. Girard refers to this event, repeated over and over in human communities across the globe, as the "founding murder."

"Religion is organized around a more or less violent disavowal of violence," Girard writes.[16] Bailie expresses the same paradox, calling archaic religion "humanity's astonishing instrument for turning murder and madness into a sacralized bulwark against murder and madness."[17]

> The amalgam of religious awe and violence that primitive religion exists to hallow made it possible for archaic societies to endow certain acts of violence with religious significance and thereby to put an end to the relentless reciprocity into which all violence otherwise tends to collapse.[18]

The three major components of primitive religion all serve this protective function. Sacrifice ritually repeats the founding murder and reclaims its beneficial effects. The original violence is unleashed, then spent; thereafter what is addressed in ritual is latent violence. A scapegoat, animal or human, becomes the receptacle for the hostilities "all the members of the community feel for one another."[19] As Bailie says bluntly, "The purpose of sacrifice is to prevent what happens when it fails."[20] Thus, in the Bible's paradigmatic story of Cain and Abel, the brother who turns to murder is the one whose bloodless offering leaves him without a sacrificial outlet.

Laws of prohibition regulate behaviors associated with mimetic conflict (like covetousness and theft), or enforce orderly distinctions (like hierarchy). Such distinctions are often lost when people are imitating each other, consciously or unconsciously. Angry rivals quickly lose their distinctiveness and become "doubles," mirror images of each other. Over time, any loss of differentiation may come to be associated with mimetic discord, prompting groups to devise complex systems of rules concerning purity and contagion—"a refusal of mixed states that looks upon undifferentiation with horror."[21] Underneath these seemingly pointless prohibitions, says Girard, the threat of violent conflict is very real.

The third pillar of primitive religion, myth, functions to conceal and legitimize sacred violence while preserving the memory of its beneficial effects. The myth assures the community that the victim was guilty as charged (a lie), while honoring him or her as the savior of the society.

Together, say Girardian thinkers, these three elements become the underpinnings for all human culture. Mimesis, after all, is only conflictual when it spreads. When concentrated on a single victim, it has a pacifying and regulating effect.[22]

Becoming like God

> And the LORD said, "What have you done? Listen; your brother's blood is crying out to me from the ground!"
> (Gen 4.10)

Given the awe surrounding the founding murder and subsequent acts of sacral violence, it is to be expected that those who took part in these events would identify them with a divine or supernatural power long after the original event. Communities that follow a system of sacrificial rites and religious prohibitions do so, not for the cathartic effect, but in order to please or propitiate the divinity to whom they have attributed that first catastrophic violence. And it works, says Girard. Observing religious prohibitions does decrease the risk that the cycle of violence will be renewed, by strengthening the cultural structure responsible for preventing that violence. Contrariwise, transgressing those prohibitions can set off a chain reaction that feels cataclysmic.

Throughout his ministry, Jesus calls on his followers to turn the old system on its head, to break Satan's hold on humankind by refusing to respond to violence with violence—in effect, to begin evolution over, this time with eyes open.

Is this the image of God, though, into which human beings are evolving? Isn't something wrong here? Human nature is fundamentally linked to community. One cannot think about what it means to be in God's image without taking social experience into account. The words of Genesis even suggest as much: "Let us make humankind in our image, according to our likeness." Whatever referent of "us" and "our" is understood, Holy Trinity or heavenly court, it suggests a God whose very nature is social, seeking fellowship.

Yet the heart of the social experience for human beings, Girardian thinkers say, is murder. What is to be made of this paradox? Perhaps, in fact, it is not such a paradox. Perhaps this social dimension of the God-image is evolving along with the species. Scapegoating came about, after all, to limit violence, at a time when human beings were hardly human yet. Once scapegoating was introduced, however, it quickly turned into the defining reality beyond which it is difficult or impossible to perceive alternatives. This insight is the reason why, from a religious perspective, revelation is so crucial for human moral development. Without the prophetic word that comes from "outside" our limited reality to challenge and liberate, human beings remain powerless to change destructive patterns.

Jesus' social behavior rejects the false determinism of history and reveals the potency of human freedom in service to God, even in the midst of the mob, as he takes upon himself the scapegoat's ancient loneliness and dehumanization.

The Hebrew Bible is unique, according to Girard, in its challenge to scapegoating. In it is found the first stripping away of the myth surrounding the victim mechanism, the first unmasking of the truth. "What have you done?" God says Cain, in a theme that recurs throughout the Hebrew Bible, persistently if not always consistently. The story of Abraham and Isaac has animal sacrifice taking the place of child sacrifice as part of human religious evolution. The Decalogue sets strict limits on mimetic rivalry, making devotion to God the path of peace. The prophets attack the three great pillars of primitive religion—sacrifice, mythology, and prohibition, "the primitive conception of the law as a form of obsessive differentiation"[23]—demanding, instead, justice for the powerless, the outsider, the oppressed. Indeed, according to Girard, prophetic Judaism and Christianity are the only religions in the history of the world that rest on a rejection of founding murder.[24] As the Bible unfolds, the call to take the side of the marginalized becomes more and more clear, like a rumble getting gradually louder.

With the gospels, says Girard, the scapegoating mechanism is finally definitively unmasked, the lie exposed. The truth about violence is laid out—in Jesus' life, in his death, and in his victory over death, proclaimed by the followers who had, not long before, sided with his persecutors. In effect, God has intervened to overcome the determinism of evolution, inaugurating a new human being not bound by the old system of scapegoating, murder, and cover-up.

The gospels' confrontation with evil begins with the temptation in the desert, in which Jesus rejects the path of violent domination, in favor of an active reliance on God. In so doing, he asserts his freedom from a human culture rooted in violence, whose organizing principle he denounces as "Satan."[25] Throughout his ministry, Jesus calls on his followers to turn the old system on its head, to break Satan's hold on humankind by refusing to respond to violence with violence—in effect, to begin evolution over, this time with eyes open. It is perhaps for this reason that the way of the gospel is invariably the way of paradox and the overturning of tables. To live into God as Jesus taught is to live with tensions and contradictions, to live as new human beings in an old and dying culture.

This old culture is rooted in self-deception: in particular, the belief that victims are deserving of violence and that God sides with the persecutors. Girard says that when Jesus calls Satan the "father of lies" (Jn 8:44), he is challenging his culture's self-deception.[26] In the mechanism of the founding murder, Satan represents both the *diabolos*—the sower of division, the seductive power of mimetic rivalry from which only God can free us—and *satan*, Hebrew for "accuser"—in other words, the scapegoating tendency of the mob. The stand Jesus takes is, thus, not merely against violence, but against that obsessive differentiation that makes harmonious relations dependent on finger-pointing, exclusion, and the impulse to get rid of whatever threatens. In its place, he offers a peace that "passes human understanding," because it comes from outside human culture in order to confront that culture once and for all.[27]

The life and teaching of Jesus is why the New Testament insists that human history, indeed creation itself, begins over with Christ, the "second Adam." So, the prologue to John's gospel begins the story over at the beginning—this time from the point of view of the invisible, unrecognized *Logos*, the God who identifies with victims.[28]

> In the beginning was the Word.... He was in the world, and the world came into being through him; yet the world did not know him.
>
> (John 1:1, 10)

Whereas the Genesis account has God expelling Adam and Eve from his presence, John tells a different story:

> He came to what was his own, and his own people did not receive him.
>
> (John 1:11)

Jesus' social behavior rejects the false determinism of history and reveals the potency of human freedom in service to God, even in the midst of the mob, as he takes upon himself the scapegoat's ancient loneliness and dehumanization. Every element of the Passion is connected to "every ritual on the planet," asserts Girard:

> ...the preliminary trial, the derisive crowd, the grotesque honors accorded to the victim, the particular role played by chance, ...the degrading punishment that takes place outside the holy city in order not to contaminate it.[29]

This time, however, the effect is not to shore up sacrificial violence, but to unmask it. Liberated by Jesus' resurrection, witnesses proclaim to any who will listen that the crucified man was innocent, like so many before him. God's self-appointed executioners (and we are all, to varying degrees, implicated) are invited to see themselves as we really are, not instruments of divine justice but scapegoaters and persecutors of the unprotected.

The Cross intercedes in history in the form of devastating insight. As the gospel proclamation spreads, evolution's grim secret is declared openly, demythologizing and exposing our complicity in the persecutions that have been carried out "since the foundation of the world" (Mt 13:35). In fact, it is working. Over the centuries, the power of the founding murder, which depends on delusion, has been steadily eroded by an awareness that cannot be driven out. Persecution evokes automatic suspicion, in everyone: Unable to believe the lies persecutors tell, others find themselves siding with the victims. This, says Girard, is a direct result of the Cross working in history.

This eye-opening activity of God unfolds slowly, almost invisibly, not by force but by invitation and, as it were, by the persuasive power of discovery. In other words, it takes place as all evolution does, whether physical, historical, or moral: by creatures groping in the darkness, adjusting to new conditions, coming to sudden discoveries, repeating errors, living into new skills and new ways of knowing.

The effects are still unfolding, in ways both good and terrible. The old system is dying—not quietly but convulsively. Large-scale slaughter and even genocide take the place of the occasional efficacious sacrifice as social groups try desperately to create the same effects of unanimity and harmony. This is inevitable, says Girard, but the outcome is by no means assured. The human species can choose the alternative, the way modeled by Jesus—or they can destroy themselves. It is not clear which path they will take.

Conclusion: dwelling in and breaking out

How does the species live into the new way of "human being" embodied in Christ? I end this paper where I began, with the insights of Michael Polanyi. To become like Christ, one must indwell Christ's life and teaching.

> Religion, considered as an act of worship, is an indwelling rather than an affirmation. God...exists only in the sense that he is to be worshipped and obeyed, but not otherwise—any more than truth, beauty, or justice exist as facts. All these, like God, are things which can be apprehended only in serving them.[30]

In this sense, Christian being is like all true knowledge: To understand it at all, one must "become it." One knows by incarnating—theories, fact, language, culture, morality. That is why acceptance of moral teaching is called "interiorization," Polanyi remarks.[31] We imitate, we rehearse; gradually we are changed. As Drusilla Scott writes, whatever we dwell in, outside ourselves, becomes a part of our thinking and knowing.[32] Applied to Christian disciples, this is what Paul calls "being in Christ." Girard calls it positive mimesis. When the human capacity for imitation is applied to others on the same level as ourselves, rivalry results. When, however, it is directed toward someone at a much higher level, such as Jesus or the saints, the result is not rivalry but spiritual advancement. This is one reason the Church plays such a crucial role in transforming culture. Human persons need role models!

If one focuses too much on the particulars, as commonly happens with faith and religious practice, one loses touch with that higher truth.[33] The task is to remain open to new knowledge—yet not too open, lest it be overwhelming. Tradition and responsiveness to the Spirit are needed; frameworks for assimilating experience are needed, and the flexibility to adapt them when experience changes.[34] Polanyi calls this "dwelling in and breaking out." Forms and traditions are indwelt, in order to go beyond them to deeper, more universal meaning.

Above all, it is necessary to have the freedom to grope after the truth of God, and to let others grope in their own way. "People need a purpose that bears on eternity." [35] For Polanyi, this means learning to live with one's moral shortcomings and those of society—not rushing to perfect, prohibit, or punish, but allowing room for God to work in it all, and letting religion be itself, free of materialism's "absurd determinist viewpoint." [36] As Paul wrote to the recalcitrant Corinthians:

> So we do not lose heart. Even though our outer nature is wasting away, our inner nature is being renewed day by day. For this slight momentary affliction is preparing us for an eternal weight of glory beyond all measure, because we look not at what can be seen but at what cannot be seen. For what can be seen is temporary, but what cannot be seen is eternal.
>
> (2 Cor 4:16–18)

Works cited:

The Bible. New Revised Standard Version. © 1989, Division of Christian Education of the National Council of Churches of Christ in the United States of America.

Bailie, Gil. *Violence Unveiled: Humanity at the Crossroads*. New York: Crossroad, 1995.

Girard, René. "The Anthropology of the Cross." In *The Girard Reader*, ed. by James G. Williams, 262-88. New York: Crossroads, 1996.

_____. "The Question of Anti-Semitism in the Gospels." In *The Girard Reader*, ed. by James G. Williams, 211-21. New York: Crossroads, 1996.

_____. "Satan." In *The Girard Reader*, ed. by James G. Williams, 194-210. New York: Crossroads, 1996.

_____. *Things Hidden Since the Foundation of the World*. Stanford: Stanford University Press, 1987.

_____. *Violence and the Sacred*. Trans. Patrick Gregory. Baltimore: Johns Hopkins University Press, 1977.

Polanyi, Michael. *Personal Knowledge*. Chicago: University of Chicago Press, 1958.

_____. *The Tacit Dimension*. Gloucester, Mass.: Peter Smith, 1983.

Polkinghorne, John. *Faith of a Physicist: Reflections of a Bottom-up Thinker*. Minneapolis: Fortress Press, 1996.

Scott, Drusilla. *Everyman Revisited: The Common Sense of Michael Polanyi*. Grand Rapids, Mich.: W. B. Eerdmans, 1985.

Endnotes:

1. Polanyi, *Personal Knowledge*, p. 383.
2. Polanyi, *The Tacit Dimension*, p. 33.
3. Ibid., p. 45.
4. Polanyi, *Personal Knowledge*, p. 385.
5. Polanyi, *The Tacit Dimension*, p. 48.
6. Ibid., p. 405.
7. Ibid., p. 4.
8. Polkinghorne, p. 15.
9. Girard, *Things Hidden*, p. 85.
10. Ibid., p. 86.
11. Girard, "The Anthropology of the Cross," p. 268.
12. Bailie, p. 121.
13. Ibid., p. 122.
14. Ibid.
15. Ibid.
16. Girard, *Things Hidden*, p. 166.
17. Bailie, p. 16.
18. Ibid., p. 25.
19. Girard, *Violence and the Sacred*, p. 99.
20. Bailie, p. 139.
21. Girard, *Things Hidden*, p. 154.
22. Ibid., p. 48.
23. Ibid., p. 154.
24. Girard, "The Question of Anti-Semitism" p. 218.
25. Girard, "Satan," p. 203.
26. Ibid., p. 204.
27. Girard, *Things Hidden*, p. 203.
28. Ibid., pp. 274–75.
29. Ibid., p. 167.
30. Polanyi, *Personal Knowledge*, p. 279.
31. Polanyi, *The Tacit Dimension*, p. 17.
32. Scott, *Everyman Revisited*, 132.
33. Polanyi, op. cit., p. 33.
34. Scott, pp. 148, 151.
35. Polanyi, op. cit., p. 92.
36. Ibid.

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Religion and Which Sciences? Science and Which Community?

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The author addresses ways in which participants in the religion-and-science dialogues avoid ethically sensitive issues involving the scientifically developed subject of nonhuman animals. Using the concept of ethical anthropocentrism, he maintains that the contemporary dialogue is mired in a traditional set of concepts and myopic discourse. The present approach entails serious risks of weakening both religious life and scientific inquiry, including the foundation for an engagement between religion and science. Furthermore, the specific sciences dealing with nonhuman animals should be engaged fully for a number of reasons related to both religious and scientific goals. A further benefit of such an engagement would be promotion of an understanding of community more responsive to the non-anthropocentric ethics found so broadly in religious traditions outside the Abrahamic, and in subordinated portions of the Abrahamic traditions.

One of the more humbling features of human history is the fact that many of the most prized and able thinkers, and indeed at times the entire academy, have avoided and sometimes even denied altogether certain ethical issues, because these subjects have been inconvenient, unpopular, or uncomfortable. Well-known examples include Aristotle's rationalization of slavery,[1] the failure of liberals in the eighteenth and nineteenth century to include women and people of color in proposed expansions of the vote and other political power,[2] and the all-too-easy accommodation of established religious institutions to a panoply of exclusivisms, including racism, patriarchy, classism, and homophobia.[3]

With this history in mind, I consider here whether something like this is occurring in Christianity's dialogue with the Western scientific tradition on the subject of the animals outside the humans species. More specifically, I want to engage certain features of the current dialogue as carried out by prominent theologians and scientists, and I will suggest that problems of avoidance and myopia do exist in the current engagement of "theology" and "science" on the issue of "animals."[4]

What prompts these questions is a baffling phenomenon—the religion-and-science dialogue seems historically to have been dominated by (1) an engagement between theologians and physicists, in particular cosmologists, and (2) a very limited engagement with only some of the implications of Darwin's ideas. As to the latter, even though Darwin's ideas deal with the human species' relationships to all other animals, those theologians who have engaged Darwin seem to have focused on the implications of his work for the design argument or for sociobiology, as well as some of the aggressive claims made in the 1970s by atheistic, scientistic biologists like Jacques Monod and Richard Dawkins.[5] If one tries to find theological circles where there has been a serious engagement with the more specific biological sciences that have grown out of the Darwinian revolution, especially those that provide highly specific information about the most complex nonhuman animals, one finds few, if any.

The answer to the question of why theologians have concentrated on physics and cosmology, but not on those biological sciences working to discover the realities of nonhuman animals, is not obvious; nor is this a topic about which one can easily generalize. One can say, however, that the trend continues. I take this trend to be the result of a pervasive and influential bias that begs the question, why is there no sustained attempt to dialogue with those portions of the scientific tradition that include the very specific and well-developed biological sciences in which astonishingly diverse information regarding other animals can be found?

The phenomenon presents some fascinating problems from the vantage point of both ethics and an understanding of religion in the lives of human beings. In this paper, I frame questions in ways that seek to open up minds on this issue. They are not meant to impugn in any way the motives or character of those involved in the current dialogue, for I read the engagement of religion with science as not only one of elegant and imaginative encounters, but also one of laudable intentions. But even if my reading of the intentions is correct, such intentions have not prevented the theologian's engagement with the scientific tradition from being subject to "conditioned ethical blindness"—that is, good intentions have not prevented the theologian from becoming so accustomed to a particular way of thinking, as to be conditioned not to see its effects or larger implications.[6]

Invitation in the form of four questions

To probe the reasons why this engagement has not taken place, or if it has, why it remains unknown and of little, if any, importance in established theological circles, I pose four specific questions. These are, I suggest, an invitation to engage the spirit of today's faith-and-science exchanges. As a practical matter, these questions force one to stay in touch with the fundamental features of the overall projects of, respectively, the scientific and the religious traditions.

1. Looking at the scholarship and discourse in the field of "religion and science," which parts of science, on the one hand, and of religion, on the other, are being fully engaged?

2. Is it possible that there has been a disproportionate emphasis on some sciences and on certain views of religion, such that the results risk being unscientific and perhaps somewhat un-religious (in the sense of being too narrowly and, thus, perhaps misleadingly mired in only one dimension of religious concern)?

3. Does the present state of the science-and-religion dialogue betray a traditional anthropocentrism?

4. Does the current state of the dialogue betray a kind of imperialism as well, focusing on only Western concepts of who and what matter in reality, which beings constitute "persons," and which animals, human or otherwise, have ethically significant complexities, such as culture, intelligence, or emotional depth?

I venture some preliminary answers to these questions, and along the way suggest that a debilitating narrowness and short-sightedness are involved in the problems I address. If this is true, engaging these problems may well help to uncover some interesting complications flowing from the current form of the religion-and-science dialogue. These complications include the following potential problems.

(a) Scholars' choices may make them complicit in the broader society's failure to grapple with certain inherently ethical themes.

(b) Scholars' choices may minimize opportunities for disseminating information of an eminently scientific nature that can be of the greatest relevance to the most fundamental values of religious traditions.

(c) Scholars' choices may result in a failure to listen to certain other dialogues, which failure can have an imperialist cast. For example, discussions of the status of nonhuman animals have long gone on, and certainly now occur, even if, in societies that draw their intellectual sustenance from the European intellectual tradition, such discussions have been relegated by the theological tradition to "non-establishment" circles.

(d) Scholars' choices may keep religious traditions in the complicated position of purporting to opine on the status of other, nonhuman lives. When such opinions continue to be held, even in the face of available and contrary information, the nature of religious affirmations or dismissals of nonhuman life must be assessed.

Beyond the generalities of science: engaging the specific realities of living beings

The issue I am pursuing can be framed by focusing on the specific and difficult set of issues that fall under the theme "religion and animals" (or, using science-based terminology, "religion and nonhuman animals"). Broadly speaking, at least the following themes fall under the religion and animals rubric: (1) learning to see the role of, and work done by, the images of nonhuman animals found so broadly in religious symbolism; (2) assessing how religious traditions have treated or otherwise engaged nonhuman animals, such as through the promotion or prevention of obvious harms to them; and (3) identifying the general role that religious traditions have had as mediators of views of nonhuman animals. In a colloquial manner, one might ask, "Have religions gotten it right or wrong regarding other, that is, nonhuman, animals?"

Regarding this general area, a review of the contemporary discussion between "religion" and "science" suggests three things: firstly, that something like a general tendency to avoid these topics, particularly the ethically charged issues, characterizes the work of those contemporary scholars now at work in the religion-and-science dialogue; secondly, that such avoidance occurs in spite of otherwise laudable intentions; and, finally, that one can learn from this recurring tendency something about the place of ethics in individual lives.

> ***Western theological tradition has found many ways to ignore the conclusion that human moral abilities beg the question about other animals. In the religion-and-science dialogue, theologians characteristically concern themselves with those sciences that allow them to avoid the inherently ethical questions that many life sciences thrust on the caring and informed moral agent.***

So let me again state the general question, although this time in a more specific form: Does the failure to engage nonhuman animals, particularly as it is reflected in the scholarship and discourse of those in the academy who now promote the religion-and-science dialogue, betray a traditional anthropocentrism that is in some ways both unscientific and unreligious?

Given that even a little research shows easily that the importance of nonhuman individuals is not a new theme (it is both an ancient concern and one still central in indigenous cosmologies), the conclusions of this article suggest that (1) there is in the Western academy currently a profound failure to deal with this subject, (2) this failure is the product of a continuing, and debilitating, anthropocentrism in ethical reflection, (3) this failure is part of a tendency to assume that mainline ethical reflection is the whole of ethical reflection, rather than merely one of the many historically and culturally conditioned options available, and (4) a failure to change this tendency will perpetuate exclusivist values that now imbalance the living and thinking of humankind.

Ethical questions: central and daily

Posing inquiries about other animals in a forum where religion is discussed is a delicate matter; it uncovers certain extremely contentious issues about the nature of human ethical abilities, and it reveals some important differences between and among religious traditions. The ethical questions are inevitable, because all human cultural traditions that are explicitly religious foreground a claim that this life is a deeply moral matter.[7] Yet, despite a consensus that human beings have special abilities to care about others, religious traditions differ in startling ways over the identities of such "others" and, in particular, over the significance of nonhuman animals. Such differences betray a profound disagreement over the most basic features of human moral abilities. For example, only some forms of religious life make the question of nonhuman animals an ethical question of the first order. The Buddhist and Jain traditions' first precept, recited daily by millions, is a moral undertaking that commits believers to avoid killing (which is, of course, paralleled by the Hindu traditions' commitment to *ahimsa*). The affirmation of nonhuman lives implicit in this ethical precept stands in stark contrast to certain claims found broadly in the Abrahamic traditions. An example, though one by no means fully representative of each and every aspect of these complex of traditions, is set forth in the Roman Catholic Church's recently revised Catechism:

> Animals, like plants and inanimate things, are by nature destined for the common good of past, present and future humanity.[8]

The differences in these two approaches provide interesting material for those who wish to argue that, in ethical matters, the Abrahamic traditions are more anthropocentric than, say, the traditions of the Indian subcontinent.[9]

The special abilities to care about others exhibited by humans lead each person, as an individual, to an inevitable set of foundational ethical questions that manifest themselves regularly in our daily lives: "Who are the others about whom we can care? And who are the others about whom we should care?" These questions are existentially relevant, perhaps natural,[10] and clearly of central importance to any religious tradition.

Answers to these questions have by no means been static across time. Both within and without religious traditions, there has been an expanding circle of protection.[11] At present, there are developments that suggest the expansion continues, such that traditional answers within the Western cultural sphere to these core ethical questions are still being revised in, among other places, legal systems.[12]

In particular, "religion and ecology" discussions increasingly engage these foundational "who are the others?" questions in vibrant ways.[13] This dialogue is characterized by non-anthropocentric perspectives that are far broader than the tradition-burdened, human-centered responses that comprise virtually all theologically based ethics in the Western cultural tradition. Yet, even in this extraordinary new development, there remain subtle ways in which the dialogue obscures "animals" as an ethical issue.[14] As discussed below with regard to the work of several theologians and scientists who participate in the current religion-and-science dialogue, present conceptual schemes (such as the trilogy, God and humans and nature) may be counterproductive for the important purpose of addressing the current marginalization of nonhuman lives. Nonetheless, the inclusivist spirit and concepts of the new religion-and-ecology inquiry, along with that of interfaith dialogue and social justice movements, push one to put analogous challenges to the contemporary dialogue between religion and science: Who are the recognized "others"? Which sciences are part of the engagement? Do exclusivist notions handed down blindly as "tradition" still hold undue control? Are theologians handicapped by, and can they get beyond, traditional exclusions and narrow discourse? Or does the dialogue energize and open minds, thereby pushing participants to think in inclusivist and broader perspectives?

I suggest below that the religion-and-science dialogue remains mired in a self-imposed predicament, and that this situation is clearly a matter of choice. Tragically, such a choice, to the extent that it continues to allow a self-serving, self-affirming, and selfish anthropocentrism to prevail, entails serious risks that threaten the integrity of the dialogue. Indeed, failure to acknowledge these risks is likely to undermine the growth of otherwise laudable efforts to engage the intersection of scientific and religious concerns.

Religion and which sciences?

One way to assess whether the current religion-and-science discussion is stuck in a narrow place is to ask which sciences are most typically engaged in dialogue by theologians, religious leaders, or believers. Consider first that anyone's engagement with science always entails an engagement with scientists who practice a specific discipline. It is often assumed that the word "science" does helpful work in descriptions of various problems. With only a little reflection, however, it becomes clear that the term "science" is at times employed carelessly and in a way that suggests that the focus and practice of science is monolithic. Such a claim, whether explicit or implicit, is misleading in the extreme.

Consider a list of some of our contemporary sciences: animal behavior, aquaculture, biochemistry, biotechnology, cetology, cognitive sciences, comparative developmental evolutionary psychology, conservation biology, developmental biology, ecology, ecotoxicology, entomology, environmental sciences, ethology, evolutionary sciences, fisheries, genetics, forestry, horticulture, marine mammal studies, microbiology, molecular and cell biology, neuroscience, nutrition, organismal biology, palaeontology, paleobiology, parasitology, pharmacology, physiology, plant biology, population biology, population genetics, primatology, psychology, systematics, toxicology, zoology. What is noteworthy about this list, which is hardly complete, is that it is composed primarily of the proliferating life sciences, and ignores oft-cited items such as physics, chemistry, astronomy, and mathematics.

Ask science-and-religion dialoguers which of these life sciences are their partners. The most inclusivist answer would likely include ecology, environmental sciences, evolutionary sciences, and psychology. Few, if any, have a deep engagement with those sciences that have developed the most advanced information regarding the most complex animals outside the human species.[15]

In casting about for answers to why one sees within the religion-and-science dialogue only certain sciences and not others, one inevitably stumbles across the fact that, in our current culture, not all sciences are created equal. In other words, some sciences are given much more respect than are others. Recall the famous quip by Ernest Rutherford, who said that science is best understood by breaking it up into two fields, "physics and stamp-collecting."[16] Physics now occupies the position once occupied by theology as the "queen of the sciences." This is, no doubt, related to the great success of physics and other physical sciences in discovery of some foundational features of physical reality, the universe generally, and especially cosmic origins. It is also related to the fact that the findings of the physical sciences have "delivered," in the sense of being a foundation for those technologies and industries that supply products for a consumer-oriented society.

The success and prestige of certain sciences, such as physics and chemistry, have dramatically affected the methods and goals of scientists in other fields. A prime example is the aspiration of psychology's behaviorist camp in the twentieth century to offer explanations more like those of physics and chemistry.[17] And, as evidenced by the discussion between theologians and cosmologists, physics is the science that has caught the fancy of many in the religion-and-science dialogue.

It is, however, worth pausing to consider further why physics, rather some of the life sciences listed above, is the science that has, in the main, engaged theologians. The elegant answers to the profoundly interesting questions of physics, or alternatively those of chemistry or mathematics or astronomy, have almost no purchase on the fundamental, existentially pressing features of our world, issues purportedly engaged by theology. Said in another way, physics, even if it deals in a limited sense with the most basic aspects of human micro- and macro-universes, as it were, has absolutely nothing to with the complexities of handling features of daily life. Given that religion, if it can be said to be "about" anything, is about daily life, there is at least some irony when a theologian or church leader gives so much reflective energy and time to heavily quantified physical sciences about issues that, in an existential sense, impact human beings very little in their immediate, intensely ethical lives.

Further, a preoccupation by theologians with the physics of the origin of the universe is, when it perpetuates ignorance about more immediate surroundings (that is, other living beings impacted by human activity), is potentially tragic. Each religious tradition has its own way of handling the fact that the religious life is about existential and immediate matters, rather than about speculative guesses, informed or otherwise, regarding the overall and most basic structure of the universe. Buddhists, for example, have the Ten *Avyākatāni*, translated variously as "the indeterminates or points not determined [by the Buddha while alive]" or "questions which tend not to edification." Indeed, the tendency to wander in soteriological irrelevancies is a hallmark of some theology, such that some people of faith repudiate it as useless.

The anomaly returns to the fore, of Abrahamic theological traditions failing radically to engage the claim that human beings, as moral agents, ought to know about nonhuman animals and then accord them fundamental protections, such as freedom from captivity or other instrumental uses.

If religion is primarily about the immediate realities of believers' lives and their need to discern moral norms and then act in moral ways, one might expect that it would be those scientific disciplines exercising the basic humility of patient observation that captured theologians' imagination. It is, after all, within the observable, nearby surroundings of one's local world, as it were, that one must act and judge the consequences of one's finite, daily choices. Said in theological terms, it is in one's own limited world that one must find God's presence. In less theological but still explicitly moral terms, religion and its essentially ethical messages about love, compassion, kindness to others, etc., are lived out on a local, daily level, not at the level that physics, chemistry, astronomy, and mathematics engage.

Perhaps the allure of opining on the most basic physical features of the cosmos, including its origin in the remote past, explains the disdainful attitude of some scientists to the "stamp-collecting" work of other scientists, such as ethologists, who patiently, humbly, and honestly describe the realities of nonhuman animals and the surrounding ecosystems. Primatologists, marine mammalogists, and specialists in elephant behavior, for example, do not call upon complex equations, Big Bangs, and subatomic particles to explain the day-to-day lives of the complex animals they study. Such work is, however, crucial in the present environment, given the radical ignorance both within and without the sciences regarding the social, emotional, and intellectual lives of the most complex of nonhuman animals.[18] Further, such painstaking and detailed research requires great discipline in order to resist applying traditional stereotypes to the animals being studied. In this sense, this kind of work represents well the humility-spawning features of scientific method.

Dismantling stereotypes of other animals, because they have been underdetermined by day-to-day realities and overdetermined by ignorance-driven bias, is crucial for another, eminently ethical reason. Caricatures of other animals remain powerful images both inside and outside the scientific tradition. Scientists who get beyond caricature and stereotype regarding the daily lives of nonhuman animals may do work that seems humble relative to the macro-level work of astrophysicists. This work is, nevertheless, of crucial importance to the ability of a moral agent to see the world in an informed way. Hence, any responsible moral agent desperately needs such detailed information to understand the impact of human actions on previously unknown realities, such as the complexities of nonhuman animals.[19]

Religion, theologians, and humility

While religious traditions have much to say about the need for basic humility, a certain kind of humility seems to be lacking in those who, despite unfamiliarity with the actual realities of nonhuman animals, nonetheless attempt to offer opinions relevant to the significance of any and all nonhuman animals. Do some major participants in the religion-and-science dialogue miss entirely the relevance of those sciences dealing with the realities of other animals that are either near human communities or far away from them? Might these be of relevance to the core features of any ethical tradition and, as such, religious traditions generally?

Relatedly, why would someone who wishes to say something about the relationship between religion and science focus only on, say, physics and its related sciences? One explanation for such a preoccupation might be that physics in the twentieth century was, in an important political and ethical sense, easy to engage. Engaging twentieth-century questions about the origin of the universe, for example, did not require much speculation about the oppressions that are an integral part of the daily struggles of many people. Someone can be deeply interested in, say, astrophysics or subatomic physics, without ever contemplating the harsh realities just outside the door, realities that provoke some moral agents to be deeply committed to a revolution in cultural, political, and economic values. In fact, if one wanted to maintain the status quo, including present oppressions, one could study physics all day and not in any way affect the patriarchy, classism, racism, or other oppressions of contemporary societies.

What is religion about, though, if it is not about day-to-day choices? If one were looking for a religion-and-science dialogue that *avoids* engagement with the daily world, the dialogue of religion with modern physics would probably be the best choice. Simply said, the contemporary engagement of theology with physics has far fewer consequences than would, say, a full engagement with social justice concerns or certain biological sciences, such as the heavily publicized work in primatology and marine mammalogy, or the less prominent work in elephant studies. Is it mere happenstance that few theologians or scholars of religion can tell an African elephant from an Indian one, or a great ape from a lesser one? Or that few religious leaders care to know either that chimpanzee and bonobo great apes share more than 99% of their active DNA with human great apes, or that humans have been referred to as "the third chimpanzee"?[20] This kind of scientific data is ignored, even as there are, literally, hundreds of theological contexts where great attention is paid to the Big Bang, quantum theory, and the Anthropic Principle.

Ethics and the local world

Like religious faith, what is ethics about if not one's own neighborhood? What one believes deeply is reflected far more fully in how one acts than in what one says of one's actions. Gandhi once framed this wisdom in a very simple form by saying, "The act will speak unerringly."[21] This aphorism about what in life discloses a person's true beliefs frames a particularly important challenge for religious traditions on any issue, including the daily challenges faced by Christian and other religious believers regarding "who the others are."

Might nonhuman animals be "others" about which human moral agents are concerned, and towards which harmful actions should not be directed, for the same or similar reasons why human individuals should not be harmed? Note what this question entails: namely, discerning whether the nonhuman individuals near the agent can and should be protected. As noted above, nonhuman individuals have indeed been recognized as worthy of protection in some religious traditions, though it is commonly said that the Abrahamic traditions are, ethically speaking, anthropocentric.[22] What are the practical implications of such ethical anthropocentrism? The implications are, it turns out, rather stark.

Generally, any ethical principle, whether religiously framed or not, must be related to the things that an individual is able to do in ordinary life. As philosophers say, "ought implies can." Thus, if I say, "you ought to do this," I have implied that you *can* do it. That, of course, involves talking realistically about your actual situation in the world. What can people do in their ordinary, ethically-charged lives, given the actual choices confronting them as agents capable of morality?

Religious ethics, though, sometimes exhibit an interest in the inverse, namely, that "can implies ought." Of course, this does not automatically apply to a wide range of situations, for just because one can do something, it does not follow that one is obliged to. But religious traditions often suggest that we ought to act just because we can, and particularly so when the context is morally charged. For example, if I can give funds to charity, ought I? In the matter of nonhuman animals, the parallel question is, if I can care about these others, ought I? In the *ahimsa*-driven traditions of the Indian subcontinent, the answer to the second question is "Yes," at least with regard to preserving other animals' lives.[23] Sometimes, then, in view of human moral capabilities, some religious traditions suggest that, with regard to nonhuman animals, the capacity to act alternatively creates an obligation not to kill them. Relying on a foundation of the special qualities of human abilities to care about others, the religious ethics of these traditions thus exemplify an inversion of the common philosophical adage, moving from "ought implies can" to "can implies ought."

Why nonhuman individuals are relevant to theology and ethics

Note that the claim here is that other animals matter as individuals, because it is in this capacity that they have particular relevance to human beings as moral agents. Why? Because individual moral agents can treat individual animals well. In fact, duties to individuals contrast nicely with moral duties to larger realities such as an entire species, an ecosystem, and the earth. Though of great importance, treating these larger realities "well" is made especially difficult by their size, complexity, and the very generality of the underlying concerns. Individuals, on the other hand, are situated differently, existing at the more "local" level of immediate and daily living. Here, they can be seen and understood, as can the direct and indirect effects of human choices and actions upon them. When specific inquiry is made in this way, it is easy to recognize identifiable impacts that human actions have on individuals, human or otherwise. As such, these consequences are comprehensible, whereas the impact of human actions on "the environment" or on the human econiche, or even on a species as a whole, is typically much harder to discern. If I run over or poison an animal, it is that individual who dies, not the species. If I buy a product that was a living animal, it is easily comprehended that the product is more than a resource that I can consume without ethically-charged consequences. A specific individual with feelings and a life was impacted because of my consumption. It is, then, simply easier to recognize how to treat an individual animal well, or to refrain from harming it, than it is to recognize how to treat the environment or a species or the earth well.

This practical aspect of engaging individuals, as opposed to the not-so-easily discerned impacts on supra-individual realities, is one feature that suits human beings to inquire about other individuals. By training children, for example, to see such impacts, parents develop their abilities as moral agents, helping them take responsibility for their own acts, one of the hallmarks of any moral system. Considering the impact of their acts on other individuals, human or otherwise, provides all persons with a very personal way of deciding how they can and will, through their individual decisions, live out a moral vision.

Hence, another peculiarity of theology failing to engage precisely those sciences that tell the most about the lives of others is the missed opportunities that such a failure produces. If religious believers fail to recognize this important dimension that other individuals (again, human or otherwise) bring them with regard to their moral abilities, they may well not develop a full awareness, a comprehensive sense of responsibility, and related virtues that are preconditions to a developed moral sense.

What is peculiar is that the Western theological tradition has found many ways to ignore the conclusion that human moral abilities beg the question about other animals. One manifestation of this avoidance seems to be that, in the religion-and-science dialogue, theologians characteristically concern themselves with those sciences that allow them to avoid the inherently ethical questions that many life sciences thrust on the caring and informed moral agent. Is this individual in front of me, even though nonhuman, such that my moral sensibilities apply? Since many sciences have shown that other large-brained social animals, such as chimpanzees, orangutans, bonobos, gorillas, elephants, and whales and dolphins, are extraordinary individuals with intelligence of many kinds, emotional complexities, social realities, personal loyalties, even cultures—and certainly the capacity to suffer in mental and physical ways—a close encounter with these sciences would inevitably prompt an ethical inquiry. Do the realities of any other animals' lives bear on one's religious life or on one's obligation to be a moral being? Clearly, the lives of many nonhuman animals' lives can be protected. Ought they be? Ought the religion-and-science dialogue engage carefully the sciences that bear on this eminently ethical issue?[24]

The realm of nonhuman animals is so internally diverse that to resort to the unqualified categories "nature" or "the world" to describe the many realities and activities of nonhuman animals is positively misleading.

What is anomalous about Western theology as a whole, aside from these obvious questions, is that Western theologians have staked out human moral abilities as their prime territory, because theologians of all stripes have been heavily invested in the claim that human beings are capable moral agents. So, the anomaly returns to the fore, of Abrahamic theological traditions failing radically to engage the claim that humans, as eminently moral beings, ought to know about nonhuman animals and, upon knowing about them, then accord them fundamental protections, such as freedom from captivity or other instrumental uses.

Note, too, that personal experience shows, generally, that many individuals, human and otherwise, often care about other nonhuman animals.[25] Why have most Western theological traditions marginalized such experiences, especially given the commitments of theology to human ethical abilities? One way to ascertain whether any nonhuman animals are legitimate moral patients (by which I mean that they are to be protected by moral agents on the issue of the fundamentals, such as life and the integrity of their familial and social bonds) would be to inquire into the research findings of the sciences that deal with specifically nonhuman animals' lives.

The analysis below suggests that, on the whole, the engagement between theologians and the most relevant life sciences remains at best at an undeveloped level, and, hence, unsatisfactory. The consequence of this is that theologians' resulting analyses all too often perpetuate ignorance, because those analyses are caricature-driven.

Some theologians

One way to investigate whether the religion-and-science dialogue is plagued by the risks I describe is to engage a range of dialogue participants who have dealt with the intersection of religion and science. Here I suggest that because certain relevant shortcomings appear in the work of prominent spokespersons involved in the modern dialogue between Christianity and the Western scientific tradition, myopic approaches end up dominating the perspectives taken in that dialogue. Both of these problems promote risks that are oddly in tension with the overall projects of, respectively, religion and science.

Wolfhart Pannenberg

I begin with Wolfhart Pannenberg, and take examples from two of his works. The first is *Anthropology in Theological Perspective*, Pannenberg's 1985 attempt to wrestle with the theological implications of certain sciences, including biology. The second work is Pannenberg's 1993 work, *Toward a Theology of Nature: Essays on Science and Faith*. Both books reflect this influential theologian's commitment carefully to engage non-theological disciplines, a commitment that pushes Pannenberg to talk about nonhuman animals at certain strategic points.

Consider this example from the earlier work. After opening the book with a chapter entitled "The Uniqueness of Humanity," Pannenberg, as part of his discussion of Herder's and Scheler's thought, says, "animals...live wholly in the present moment, ignorant of both future and past."[26] This claim about nonhuman animals' lack of a sense of time seems to be a factual assertion, given that Pannenberg cites as support two scientific works from 1937 and 1958.[27] But as evidenced by references that he cites later in the book,[28] Pannenberg plainly knew of other scientific work that strongly suggested that the cognitive levels of some nonhuman animals (he concentrates most fully on chimpanzees) are such that they do have a sense of future and past, and are, thus, far more cognitively complex than implied by Pannenberg's dismissive generalization.

More interesting than this misstatement, however, is the fact that Pannenberg was, at that time, clearly aware of the growing body of knowledge regarding the more complex nonhuman animals. Hence, given that he chose to present only evidence supportive of his statement, while ignoring counterfactual evidence, one is tempted to conclude that this otherwise remarkable thinker was, in this work at least, not concerned about his perpetuation of a stereotype of nonhuman animals.

The history of this dismissive stereotype is as long as it is intellectually bankrupt. It has been a prominent feature of philosophers' and theologians' uninformed dismissal of the complexities of nonhuman animals since ancient Greek times.[29] Through use of a caricature underdetermined by the factual realities of the animals he dismisses, Pannenberg stands in the long line of those who have chosen selectively from available images of nonhuman animals, in order to confirm a preexisting bias. In Pannenberg's case, the bias takes the form of the proposition that only human beings are complex enough to deserve fundamental moral protections. This is a claim that Christianity's mainline theological tradition has long underwritten, even though it is not in any way essential to soteriological discourse.

There are substantial risks in Pannenberg's approach, however, the most obvious of which is that such a wide-ranging dismissal of all nonhuman animals will be contradicted by simple empirical data. Another risk is the charge that the selection of evidence is driven by a pre-existing agenda. Pannenberg's selectivity regarding evidence begs the question of whether his pre-existing agenda is the mainline Christian theological tradition's longstanding bias for humans. When this or any other bias replaces a humble exploration of the realities of other animals, to which well-executed scientific methods ideally lead, the resulting claims may well distort the described realities.[30] Worse one risks the perpetuation of stereotypes and caricatures.

Consider how Pannenberg does this regarding chimpanzees, closest evolutionary cousins to human beings.[31] He contrasts them with human beings, who

> have past and future...because unlike the animals [that is, any and all nonhuman animals], including even the chimpanzees, they are able 'to loosen the bonds imposed by the situation and to distance themselves from it.' [32]

As noted above, when Pannenberg made these claims in 1985, much attention was being given to Goodall's work that showed in many ways that existing perspectives in science regarding chimpanzees were radically inaccurate and inadequate.[33] Additionally, the work of Gallup and others regarding the high level cognitive skills and self-awareness of some nonhuman animals had been available for more than a decade and a half.[34] Given the mainline Christian theological tradition's refusal to countenance nonhuman animals generally, Pannenberg's implicit acceptance of the traditional derogation of all nonhuman animals is not surprising. What is troubling, however, is Pannenberg's desire to opine about all nonhuman animals, even when neither science nor the theological tradition had explored many of the more complicated animals in any detail.

Surprising discoveries continue to pour in, such as humpback whales' complex "songs,"[35] elephants' heavy use of subsonic communications, and bottlenose dolphins' self-awareness.[36] At the very least, such reports and, in particular, the pace of new "discoveries" suggest that present perspectives, and surely traditional perspectives, are subject to radical questioning, and that conservative use of dismissive generalizations is in order.

One result of Pannenberg's acquiescence in traditional theological dismissals of any and all nonhuman animals is his uncritical use of the traditional vocabulary regarding nonhuman animals generally. This vocabulary has been dismissive, dualistic, and correspondingly unresponsive. When engaging science, a tradition that counts humans as animals, Pannenberg consistently uses the word "animals" to mean "all nonhuman animals." This habit and others, such as his use of terms such as "lower animals," suggest that Pannenberg was, from the beginning of his project, predisposed to accept data from the scientific tradition that confirm his theological bent, but not to acknowledge or search out counter-factual evidence or to explore the implications of ongoing change and discovery.

Through use of a caricature underdetermined by the factual realities of the animals he dismisses, Pannenberg stands in the long line of those who have chosen selectively from available images of nonhuman animals, in order to confirm a preexisting bias.

The same pattern appears in his 1993 work, *Toward a Theology of Nature*, although now the discourse is enriched primarily by Pannenberg's desire to work with terms and concepts that are prominent in the developing Western ecological tradition. In this shorter work, as in the longer, Pannenberg never engages detailed studies of any actual animal groups, despite an obvious commitment to engage science realistically ("Our task as theologians is to relate to the natural sciences as they actually exist...."[37]).

Taking notice of which sciences Pannenberg engages "as they actually exist," however, and to what extent he engages them, one can see that soaring rhetoric masks a not-so-subtle predisposition to refrain from disturbing the anthropocentrism of the theological tradition in which Pannenberg is working. In other ways, to be sure, Pannenberg is known for challenging traditional and hidden agendas, as when he describes Karl Barth's theology:

> The most remarkable example of the theological retreat from a discussion of the scientific description of nature....[38]

Pannenberg's selective engagement with the scientific tradition, however, subjects him to an objection that parallels his own criticism of Barth's decision:

> [I]n principle a theological doctrine of creation should not concern itself with scientific descriptions and results.[34]

Discussion of the physical sciences, coupled with a one-sided handling of a few biological sciences, is not likely to disturb the hegemony of humans. Yet a careful, extended engagement with ethology and related disciplines will reveal how impoverished theological work is when it ignores "scientific descriptions and results," as Barth advocated. In particular, the developed fields of cetacean studies and primatology, filled with patient observations regarding social, cognitive and other complexities of bottlenose dolphins, chimpanzees, bonobos, orangutans, gorillas, and some other primates, suggest that dismissals of any and all nonhuman animals are agenda-driven rather than reality-responsive.

Because in the life sciences, as Kathleen Gibson summarizes, "All of the human-ape dichotomies so cherished by the anthropologists and psychologists of the early 1960s have fallen," [40] theological work that attempts to make claims about human complexities relative to those of other animals is at great risk of perpetuating caricatures when it steers clear of a full engagement with evidence and perspectives that challenge human uniqueness in areas of consciousness, emotion, social complexity, intelligence, and communication. Hence, when Pannenberg effectively ignores the scientific evidence that would disturb his inherited theological premises, his approach becomes, *de facto*, not unlike Barth's dismissal of scientific findings. His claim that theologians must "relate to the natural sciences as they actually exist" [41] should not be allowed to obscure the fact that only *some* sciences and *some* evidence are informing his analysis. Failure to engage bodies of work and research that are directly relevant to the theological claims being made subjects Pannenberg's theological work to many charges, not the least of which is that it is just another overstated and ignorance-driven claim.

Thus, even when Pannenberg mentions specific work with specific nonhuman animals,[42] his arguments ignore so much of the available evidence that his conclusions, characteristically framed as dismissive generalizations, are positively misleading. An example occurs in *Toward a Theology of Nature*, when Pannenberg is working with Teilhard de Chardin's insights:

> [T]he fact of consciousness, which, according to our observation, appears clearly only among human beings amidst the entire expanse of nature.[43]

This implicit dismissal of the existence of complex cognitive and emotional abilities in any nonhuman animal flies in the face of available evidence.[44] The evidence was such that Donald Griffin, Harvard University's respected cognitive ethologist, could, only a few years after Pannenberg wrote, state flatly:

> The question of self-awareness is one of the very few areas of cognitive ethology where we have some concrete experimental evidence.[45]

Pannenberg's broad dismissal, then, especially because it takes place in a milieu of discovery and constant challenges to traditional claims of human uniqueness, are also contrary to the basic humility that science and religion enjoin upon the human seeker. If one asks questions, such as "How well is the entire range of life known?" or "What do cetaceans do underwater with their large brains and complex communication and social systems?", the answers are, respectively, "Not very well yet" and "We don't know." So why opine about a broad subject when the Western tradition has been shown to be, on the whole, so out of touch with and dismissive of realities outside of the human species?

Pannenberg's engagement with "science" is, thus, not led by a vigorous curiosity when he works with the issue of nonhuman animals. Refraining from any informed, detailed-oriented exploration of the biological creatures that he dismisses, he is badly in error on the issue of some other mammals' cognitive and existential complexities. In the end, Pannenberg simply does not tarry long enough with any real-world nonhuman animals to see theological and ethical significance in their realities.

There are, of course, lots of ironies in the cursory approach he uses. The editor of this work, Ted Peters, notes in his introduction,

> Perhaps the most startling and dramatic contribution of Wolfhart Pannenberg to recent theological discussion has been the initiative he takes in posing theological questions to natural scientists.[46]

But one must again ask, which natural scientists? The major questions one can pose to Pannenberg's approach to science are, from the vantage point of ethologists, cognitive scientists, or comparative psychologists, questions about its incompleteness. And more, this shortcoming calls into question this work's relevance to an informed and vibrant religion-and-science dialogue.

In summary, Pannenberg's limited engagement undercuts the value of his conceptualization and discourse, and ultimately his theological work. The result, at least on the subject of nonhuman animals, is a work governed by a sterile and anthropocentric agenda that is, upon examination, in tension with many of Pannenberg's announced themes. That this all-too-obvious agenda is not challenged by his fellow participants in religion-and-science discussions speaks volumes about which of the sciences are deemed relevant to theology and to the religion-and-science dialogue itself.

Gordon Kaufman

A similar attitude appears in Pannenberg's contemporaries.[47] I shall focus on only a few of the relevant texts, however. Consider some features of *A Global Ethic: The Declaration of the Parliament of the World Religions*, written by Hans Küng and Karl-Josef Kuschel. In particular, consider how the concept and word "animals" is used. There are but two brief references to nonhuman animals,[48] and these both appear with the word "plants." In effect, nonhuman animals are given the same status as plants in this document dominated by human-centered interests.[49]

To avoid the conclusion that the Western theological tradition as a whole, or, similarly, that the religion-and-science dialogue generally, is characterized by the patterns appearing in the cited works of Pannenberg, Moltmann, and Küng, one could argue that these three giants of modern theology are representative of only a limited part of that tradition, say, the German or European tradition of anthropocentric theological reflection. But I want to suggest that the habits of mind exemplified by them are pervasive in the Western theological tradition, as well as in the religion-and-science dialogue generally. I will do this with examples from the altogether cosmopolitan theologian Gordon Kaufman and his book, *In Face of Mystery: A Constructive Theology* (1993).

Kaufman's well-respected work is, from the beginning, dominated by a trilogy of concepts that might best be summarized by this phrase, "God, humanity, and the world."[50] For example, in his opening chapter, "The Question of God," Kaufman repeated writes of three general categories: God, the human, and all else, referred to by terms such as "the natural order," "the vast universe," and "the world in which we live."[51]

This trio of categories is, of course, common in the academy, prevailing especially in the many subdisciplines of religious studies. It is also characteristic of the discourse of politics and many other institutions. Consequently, given its traditional nature and widespread occurrence, its dominance may not appear at first to be problematic in any way. Challenges to it might seem, for many, the work of eccentrics. But some of the very insights that Kaufman himself advances can be used to problematize the trilogy, especially with regard to its underlying generalizations and the ways in which it operates as a covert dualism, that is, as a theo-anthropocentric form dismissal of anything beyond the human realm.

First of all, the concept of God is, as Kaufman and so many other theologians have creatively suggested, not a simple concept. Secondly, in the same way that Kaufman notes that claims about God are problematic and conditioned, he also observes that claims about "human nature" are notoriously plagued by the same problems.[52]

Thirdly—and most pertinent to the specific argument being made here—generalizations made about "nature" or "the world" are, like the notions of God that Kaufman openly challenges, so coarse as to be woefully inadequate to describing the complex realities they seek to encompass. The realm of nonhuman animals is so internally diverse that to resort continually to the unqualified categories "nature" or "the world" to describe the many realities and activities of nonhuman animals is positively misleading for any number of reasons. Of relevance to this argument is the fact that the use of "animals" to designate all nonhuman animals is, ethically speaking, particularly problematic. The use of such wooden categories obscures realities widely recognized outside the Western theological tradition as having major ethical significance. For example, in the Indian traditions, the especially complex features of elephants' lives, such as their learning ability and their deep loyalty to their family units (owing to their large brains and capacity for complex emotions) have caused them to be singled out as animals that are recognizably more complicated than most other living beings.[53]

One of the consequences of constantly assuming that this trilogy operates well as a meaningful description of the essential elements of our experience is that the components of the third category are, subtly and sometimes not so subtly, equated to one another. While human beings are foregrounded in the trilogy, as is God, the complexity of the remainder of this world, though surely recognized, is obscured in some crucial ways. Beyond the fact that plants, econiches, and entire ecosystems (each of which may command an ethical response) are in the "nature" category, consider who and what are contained in the subgroup of "animals": dolphins and whales, with the largest brains on Earth, exist alongside insects; great apes, sharing 98.4% of their genetic material with human beings, walk alongside slugs, but not with human beings; elephants stand next to creatures so small they cannot be seen without magnification.

With such a potent blurring of extra-human realities, important and ethically significant realities clearly recognized in other major ethical traditions are inevitably obscured. For example, the unique complexities, problems, and challenges of ecological thinking can easily be equated with the altogether distinct issues arising out of the human relationship to, and relations with, nonhuman animals. Thus, even if nuanced uses of the trilogy do in some instances lead to insights and help in countering the astonishing ethical anthropocentrism of the Western intellectual tradition, in many other instances clumsy use of the trilogy clearly affirms the anthropocentric theological heritage, including its meta-message that there are no major entities in "the world" that compete for the centrality given to human beings. In short, terms like "the world" or "nature" fall far short of doing adequate work when they attempt to name, encompass, and account for the many different kinds of lives, ecosystems, and other realities outside the human sphere.

The fields of cetacean studies and primatology, filled with patient observations regarding social, cognitive and other complexities of bottlenose dolphins, chimpanzees, bonobos, orangutans, gorillas, and some other primates, suggest that dismissals of any and all nonhuman animals are agenda-driven rather than reality-responsive.

A further consequence of the trilogy being a principal conceptual map is that, like the discourse and theologically-dictated focus of Pannenberg, this map seems to have little room for the sciences that focus on nonhuman animals, or what Kaufman refers to as the "lower animals." [54] Kaufman in the end, though riveted by the existing religion-and-science dialogue, spends no time at all on sciences that carefully engage nonhuman animals.

Consider the underlying conceptual point that Kaufman, a profoundly interesting scholar of the theological tradition, makes when summarizing "Troeltsch's critical analysis of the concept of 'essence of Christianity' itself":

> [H]is massive historical work [showed] that Christian faith, as presented by most modern theologians, was in fact largely a configuration of modern western liberal values. Troeltsch showed that the belief that there is some historically demonstrable 'essence of

> Christianity' (as Schleiermacher, Harnack, and others had supposed) was simply false....[55]

This same kind of deconstruction of an image can be applied to the constructed character of the image of "the world" or "nature" outside the human species. Contemporary work by primatologists,[56] as well as the anti-essentializing critique of certain feminists and post-modernists, suggests that the tendency to lump all nonhuman realities into one group, and then to pretend to understand that group as a single unit meaningfully contrasted with "humanity" or "God," is a misguided enterprise. The nonhuman world is simply too busy, diverse, and complex to be "essentialized," and attempts to reduce all of the complex biological realities outside humans to one category say much more about the claimant's own limited perspective than about nonhuman life generally or the rich, interdependent web of individuals, communities, and processes sometimes refered to as "nature."

One example shows well how Kaufman's treatment of all nonhuman animals parallels Pannenberg's dismissal. When referring to "forms of life less complex than *Homo sapiens*," Kaufman uses the following reference to dogs and cats as representative of nonhuman animals:

> A hungry dog, for example, seeks food.... A cat...is capable of stalking its prey for hours. Many animals, thus, have behavioral capacities similar to what, in human beings, becomes intention and attention. But there is a very important difference: animals pursue goals which have been set for them directly by their organic needs and instincts, that is, by nature (or perhaps, in the case of domesticated animals, by their trainers). Humans, however, pursue (along with such "natural" goals) artificial objectives, that is, goals learned from their culture.... [57]

Kaufman then goes on to assert humans are free to choose, while nonhuman animals are not.

> In this respect humans are agents in a way that other animals are not: they can intend and attend deliberately, and not only as a function of biological need or impulse.[58]

This statement is, first of all, inaccurate factually. There are some complex animals, for example, the nonhuman great apes,[59] that do "intend and attend deliberately." Furthermore, Kaufman's use of familiar domestic animals, dogs and cats, loads the case dramatically against nonhuman animals generally. Domestic animals can be domesticated precisely because they have social instincts that allow them to be subordinated to their human companions.[60] Animals that are subordinate to human beings, though important in their own right, hardly represent the many animals that cannot be subordinated. Nor do cats and dogs, relatively less complex mammals, represent well the startlingly rich cognitive abilities of, say, the larger-brained primates, cetaceans, and elephants.

Note as well that Kaufman, perhaps as wide-ranging a theologian as there is, remains extremely narrow when discussing nonhuman animals.

> All forms of animal life—and particularly the higher forms—have some sort of "subjectivity" or "awareness." ...However, although the animal has such feelings, it is not conscious of them as feelings; nor is it conscious of their appropriateness (or inappropriateness) to certain objects in the environment or of the connection with its behavior. This more complex sort of awareness, which I am here calling 'consciousness,' emerges only for the linguistic animal—the human person—who is able to objectify for herself or himself these 'inner states' by means of words which name them.[61]

As noted above, by 1993, when this work was published, there were many accredited scientific studies that confirmed that individuals in a number of other species (including at least bottlenose dolphins, orangutans, bonobos, and chimpanzees) had not only consciousness and complex sorts of awareness, but self-awareness and the ability to comprehend and use various features of human language.

What is even more relevant is the tenor of Kaufman's comments about the tentativeness of scientific knowledge, which he emphasizes is also a problem with knowledge of the divine. Tentativeness also dominates claims about many nonhuman animals, above all the more complex social animals. Of equal relevance is the likelihood that "our story" about "them" is likely to continue to change at a rapid pace. Many nonhuman animals simply have not been studied carefully, a by-product of the crass over-generalizations that Western intellectual, ethical and theological traditions, and now indirectly Kaufman in his turn, have used to describe and thereby effectively obscure the varied realities and possibilities of nonhuman animals. Consider, then, how fully relevant Kaufman's insights regarding images of God might be to the impoverished images of nonhuman animals, images that continue to dominate industrialized societies, mainline religious institutions, and the religion-and-science discussions.[62]

Terms like "the world" or "nature" fall far short of doing adequate work when they attempt to name, encompass, and account for the many different kinds of lives, ecosystems, and other realities outside the human sphere.

As Kaufman suggests regarding images of the divine, I suggest that the constructed, self-serving features of cultural and theological imagery of other animals need to be unpacked. Such archeology on our own views, using Kaufman's emphases on imaginative construction, mystery, humility, and serendipity, could, if applied to the complexities of nonhuman animals, provide much food for theological thought.[63]

Arthur Peacocke

The same divine/human/world trilogy dominates the work of Arthur Peacocke, one of the major scientists participating in the religion-and-science dialogue. The trilogy is, for example, announced in the subtitle of his important *Theology for a Scientific Age: Being and Becoming—Natural, Divine and Human.* There is, however, much in this science-intensive work that implicitly suggests the trilogy will be radically inadequate for tasks central to religious inquiries, the scientific enterprise, and, hence, the religion-and-science dialogue. For example, echoing Aristotle's famous claim that humans by nature desire to know,[64] Peacocke titles his Chapter 2, "What's There?" If, as Peacocke suggests, human beings naturally ask this question, human inquiries should be, in many places and many cultures, rather wide in their range. These inquiries would, in such a case, lead to rich traditions of seeking out the actual realities of, among other things, a wide array of nonhuman animals.

History, unfortunately, does not suggest that this has been the case. The Buddhist tradition, for example, "on the whole... shows little interest in questions of natural science."[65] In the Western intellectual tradition, for prolonged periods of time, human learning traditions, despite Aristotle's elegant claim about human curiosity, were mired in the *auctores* tradition of passing along inherited information regarding nonhuman animals, rather than seeking out confirmation in nearby empirical realities.[66]

Peacocke himself seeks to engage biological sciences extensively.[67] Of the intellectually influential debate over sociobiology, Peacocke writes,

> Clearly this whole development is of theological concern. For, by thus encompassing in one theory human culture and the non-human biological world (especially in its genetic aspects), sociobiology must inevitably influence our thinking about what human beings are.[68]

Peacocke recognizes that an engagement with science has crucially important limits, since worshipping the god called Science, so to speak, is just as idolatrous as worshipping other false idols.

> The tendency to imperiousness in our intellectual and cultural life has been dubbed 'scientism'—the attitude that the only kind of reliable knowledge is that provided by science, coupled with a conviction that all our personal and social problems are 'soluble' by enough science.[69]

But even if a fascination with science has its limits and risks, Peacocke clearly privileges much scientific discourse. When he talks of biology,[70] for example, Peacocke emphasizes the need to work creatively with standard biblically-based views, such as the claim that death is a consequence of human acts. Because of this emphasis on getting beyond traditional formulations and their debilitating and misleading tendency to anthropocentrism, one might expect Peacocke to be free of any form of unscientific anthropocentrism. But the central role of the same trilogy one finds in Kaufman, especially in light of its obscuring of nonhuman animals, suggests that Peacocke's analysis is still dominated by the pre-scientific ethical anthropocentrism that has dominated the Christian tradition out of which Peacocke comes. This exclusivism, so often ignorance-driven, is simply inadequate for the ethical tasks that are at the center of any soteriological tradition. Further, it is arguably contrary to the open-minded spirit of the scientific enterprise. It can hardly, then, be the basis of a healthy, open, and humility-driven religion-and-science dialogue.

Ian Barbour

Ian Barbour's lucid and synthetic corpus dealing with religion and science, a good example of which is *Religion and Science*,[57] reflects similar language and mental habits regarding nonhuman animals. In that the scientific tradition's recognition of human kinship with nonhuman animals is fully honored by Barbour, this work exemplifies the need for informed engagement. But because the discourse reflects the peculiar tradition of treating all nonhuman life as a single sphere which is radically separate from humankind in crucial theological and ethical ways, a dualism is inadvertently advanced.[71] What makes the dualism most noticeable is that Barbour himself[72] discusses the shortcomings of dualistic thinking, even as he uses the inextricably dualistic conceptuality, "humans and animals." Barbour offers an important historical lesson: "every group tends to absolutize itself...."[73] This observation is eminently applicable to the well-known human phenomenon of the marginalization of one or more individuals by the action of a group, but it is equally relevant to some societies' and religious traditions' marginalization of all nonhuman life.

John Polkinghorne

Before concluding with John Polkinghorne's recent and valuable introduction to general issues in the religion-and-science dialogue, *Science and Theology: An Introduction*, it must be noted that it does not, as a logical and psychological matter, follow that an emphasis on the humilities of religion or science, or even talking of humans as within the animal sphere, would eliminate the propriety of references to human dignity or a uniquely human place in the world. But these humilities do suggest that it is not accurate to talk of all other animals "leading up" to humans. In fact, such a framing of our relationship to other living animals is not at all Darwinian (a revolution that Polkinghorne says is to be reckoned with). Chimpanzees are, like human beings, a current end-point of the evolutionary process, not a "lower" form from which human beings evolved. Like other life forms, people and chimpanzees are co-companions at today's stage of evolutionary development, as are all other living beings. Human beings did not evolve from any of them; they evolved, along with chimpanzees, from a common ancestor. In one sense, both species are equally "evolved."

Polkinghorne suggests that science, like so much of religion, counsels a fundamental humility when searching the world. A commitment to non-arrogance, as it were, creates opportunities for both openness and inclusiveness. It can be supported, at least psychologically, by the all-too-frequent revelation that in the past many claims of "knowledge" have proven wrong.[74]

What is of concern in this work by a leading participant in the religion-and-science dialogue is the scientifically inaccurate claim that humans alone possess self-consciousness.[75] This is an odd assertion, given both the available evidence when this text was written and what Polkinghorne himself says about the nature of science. For many reasons, science is, according to Polkinghorne, dogged by uncertainties, and thus must be practiced with a certain humility. Polkinghorne's own claim about humans alone possessing self-consciousness violates a number of basic scientific canons, not the least of which is that an absence of evidence hardly equates to evidence of absence. It also violates the spirit of his observations about the many reasons supporting the need for humility. He explicitly cites the clouding up of our vision by the extraordinary complexity of what is going on in the natural world, the fact that sciences are not particularly adept at judgments regarding what happens everywhere and at all times, the long history of radical revisions in various sciences across time, and the fact that science is practiced in communities dominated by "ways of thinking which are all the more influential for being tacit rather than explicit."[76]

All of this applies fully to what the Western intellectual and scientific traditions have claimed about human beings relative to nonhuman animals (as noted above). Humility, whether theologically or scientifically driven, suggests that participants in the religion-and-science dialogue ought to be, at the very least, conservative on dismissing nonhuman animals' complexities.

Two qualifications

There are, to be sure, many other works within the Western theological tradition that are far less informed about and less sympathetic to either science generally or nonhuman animals. Examples include works within liberation theology[77] and liberal theology. Even the work of Andrew Linzey, the foremost advocate of the obligation of theology to concern itself with nonhuman animals, fails to engage contemporary science or the relevance of empirical investigation generally.[78]

As Kaufman suggests regarding images of the divine, I suggest that the constructed, self-serving features of cultural and theological images of other animals need to be unpacked. Such archeology on our own views, using Kaufman's emphases on imaginative construction, mystery, humility, and serendipity, could provide much food for theological thought.

Another important qualification is that there are important exceptions in the religion-and-science dialogue to the general trend to ignore nonhuman animals. A very bright spot, for example, is the work of Thomas Berry. This "geologian" is very comfortable with explicit inclusion of nonhuman animals within ethical boundaries, a feature of his work that may be a result of the fact that he studied non-Abrahamic traditions extensively early in his career.[79] Another example of inclusion is the work of Brian Swimme.[80]

Science and which community?

I have suggested above that the term 'science' misleads if it is employed in ways that suggest that the scientific tradition is univocal, dominated by a single method, or value-free. Because science is diverse, the scientific tradition has, regarding nonhuman animals, diverse resources upon which one can draw when participating in any religion-and-science dialogue. Of further relevance to the possibilities of the religion-and-science dialogue is the fact that some scientific experimentation, especially as it is practiced today, is complicit in the modern academy's and industrialized societies' dismissal of nonhuman animals. The use of nonhuman animals in biomedical experiments, as sources of replacement body parts for human transplantation, and in industrial testing of non-essential consumer goods is rampant. This results, sociologically at least, in scientific institutions having a vested interest in nonhuman experimental subjects being denied the kinds of moral rights and protections that would prohibit them from being used as scientific tools.

While such denials may have the approval of some religious institutions,[81] the phenomenon as a whole is driven by secular realities and values. Hence, one of the reasons that the modern religion-and-science discussion has not addressed the significance of other animals is science-driven and not directly related to the Western theological tradition's shortcomings regarding nonhuman animals. Simply said, scientists and scientific establishments have, for their own reasons, often ignored nonhuman animals as subjects worthy of ethical concern.

An examination of scientific practices suggests that there is an implicit moral community within any modern scientific circle. As a practical matter, it has been human beings alone who have been identified as the living beings deemed moral patients and thus entitled to protections.[82] Thus, the "community" so honored by many scientists is often extremely narrow, and the assumptions, generally speaking, have not been challenged by the mainline theological traditions of the Abrahamic religion.

A fascinating, even if dismaying, chapter of our intellectual history, and certainly one relevant to the likely content of any religion-and-science dialogue that goes forward in Western intellectual circles, is that both scientific and religious groups speak similarly regarding humans and other animals. Note the functional equivalence, as well as the vocabulary similarity, between (1) the following scientists' comments and (2) the comment on animals in the 1994 Roman Catholic Catechism. The catechism reads as follows:

> Animals, like plants and inanimate things, are by nature destined for the common good of past, present and future humanity.[83]

Peter Gerone, a biomedical scientist who directs the Tulane Regional Primate Research Center, was asked several years ago why he supports the view that human beings are exempted from experiments, while all other animals are not. Gerone replied:

> In my own mind, it comes down to the question of which do I want to help the most, animals or people.[84]

Similarly, the respected brain research scientist Stuart Zola-Morgan justified his invasive, harmful experiments on nonhuman primates in this way:

> I think a human life is more valuable than an animal life.[85]

As noted above, the "human and animal" dichotomy is eminently unscientific; it also is as plagued by logical problems as would be the phrase "people and Englishmen."

A broader view of religion and science

In the complex, internally diverse spheres of religion and science, there has been, historically speaking, no single answer to the question, "Who are members of our community?" When one considers the wide range of ecological visions found in the sciences and the religious traditions, especially across time and place, it becomes obvious that religious believers have often included within the moral "community" many living beings not currently so recognized in the institutionalized practice of science today. Because some religious traditions readily include nonhuman life, while others do not, the continuing anthropocentrism of the religion-and-science dialogue is baffling. Perhaps it can be explained as the result of the prevelance of a one-sided interpretation of the Abrahamic traditions. It is well documented, however, that religious traditions have extraordinary resources for other, nonanthropocentric views. For example, in the Christian theological tradition, there are vast resources in the sacramental and creation theologies for affirmation of nonhuman realities,[86] as well as tremendous investments in praxis/ethical concerns and development of human individuals' abilities for compassion and love. Hence, in the Islamic, Jewish, and Christian traditions, one can easily find individuals who treat nonhuman animals with great compassion. It is also well known that in other religious traditions there are at least as many "conceptual resources." [87] Included would be fewer dualistic divisions, more ethics-driven compassion, and less emphasis on rationality as a distinguishing characteristic.

Remaining questions

Questions might be asked about the adequacy of conceptual approaches, such as the divine/human/world trilogy mentioned above, that are, I suggest, fundamentally ethical in nature. As such, these questions will quite naturally be a matter of the deepest concern to religious traditions.

- Which religious traditions and subtraditions should have a "voice" of relevance in this matter? Which sciences?
- What is the relevance of the actual realities of nonhuman animals' lives?
- How does one recognize and deal with the fact that the methods and choices of the practitioners of various individual sciences promote, on the issue of the extent of community, one religious view over other religious views?
- Should religious traditions work to correct imbalances and biases for anthropocentric views that have, historically, dominated science as practiced?

Conclusion

Although the theme of the importance of nonhuman individuals is not a new theme, there is a profound failure to deal with this subject in the current religion-and-science dialogue. A principal cause of this failure is a continuing anthropocentrism in mainline or traditional ethical reflection, which is often assumed to be the whole of ethical reflection rather than merely one of the many historically and culturally conditioned options available. The continued failure of dialogue participants to address creatively the findings of the sciences that study nonhuman animals threatens to perpetuate the exclusivist values that now dominate the dialogue. The same anthropocentrism, in its ecological forms, has imbalanced many people's way of living and thinking in the modern, industrialized world. Additionally, the approach to nonhuman animals presently dominating the religion-and-science dialogue is imperialist, in the sense that it continues the long tradition of obscuring alternative views found in the lifeways of the people whose worlds, lives, cultures, and minds were colonized, catechized, and destroyed by the missionaries of European culture.

The manner in which a range of alternatives to traditional ethical anthropocentrism can promote truer, richer community is relevant to how religious believers and theologians can engage the sciences generally and, more specifically, those sciences dealing with nonhuman animals. Foregrounding the explicit and implicit features of the exclusivist recognition of humans as the only biological beings deserving of fundamental ethical protections can help participants in the religion-and-science dialogue see fundamental features of which religions, which sciences, and which communities they have been engaging, as well as those they can engage in the future. It can also help them be more responsive to the shortcomings of anthropocentric ethics found so broadly in contemporary discussions regarding religious, scientific, and secular stories of the universe. A continuing failure to challenge the prevailing tendency to ethical anthropocentrism will lead to a progressive impoverishment of the religion-and-science dialogue and a perpetuation of the exclusivist values that now imbalance human life and thought. These consequences, I submit, will be contrary to, and counterproductive for, the most basic values of any religion or science.

Works cited:

Aristotle. *Metaphysics.* In *The Complete Works of Aristotle: The Revised Oxford Translation*, ed. by J. Barnes, vol. 2, 1552-1728. Guildford, Surrey, and Princeton: Princeton University Press, 1984.

_____. *Politics.* In *The Complete Works of Aristotle: The Revised Oxford Translation*, ed. by J. Barnes, vol. 2, 1986-2129. Guildford, Surrey, and Princeton: Princeton University Press, 1984.

Barbour, Ian. *Religion and Science: Historical and Contemporary Issues.* San Francisco: HarperSanFrancisco, 1997.

Bawer, Bruce. *Stealing Jesus: How Fundamentalism Betrays Christianity.* New York: Crown, 1997

Berry, Thomas. *The Dream of the Earth.* San Francisco: Sierra Club Books, 1990.

_____. *The Great Work: Our Way into the Future.* New York: Bell Tower, 1999.

Bestiary: Being an English Version of the Bodleian Library. Trans. Richard Barber. Oxford M.S. Bodley 764, with all the Original Miniatures Reproduced in Facsimile. Woodbridge, Suffolk: Boydell Press, 1993.

Blum, Deborah. *The Monkey Wars.* New York: Oxford University Press, 1994.

Byrne, Richard. *The Thinking Ape: Evolutionary Origins of Intelligence.* Oxford: Oxford University Press, 1995.

Callicott, J. Baird, and Roger Ames. "The Asian Traditions as a Conceptual Resource for Environmental Philosophy." In *Nature in Asian Traditions of Thought: Essays in Environmental Philosophy*, 1-21. Ed. J. Baird Callicott and Roger T. Ames, Albany: State University of New York Press, 1989.

Catechism of the Catholic Church. London: Geoffrey Chapman, 1994.

Cavalieri, Paola, and Peter Singer, eds. *The Great Ape Project: Equality Beyond Humanity.* New York: St Martin' Griffin, 1993.

Chatterjee, Margaret. *Gandhi's Religious Thought.* Notre Dame, Ind.: Notre Dame University Press, 1983.

Clutton-Brock, Juliet. *A Natural History of Domesticated Animals.* London: Cambridge University Press, 1987.

Dawkins, Richard. *The Selfish Gene.* New York: Oxford University Press, 1976.

Desai, Mahadev. *Day to Day with Gandhi.* Varanasi: Navajivan, 1968-1972.

Diamond, Jared. *The Rise and Fall of the Third Chimpanzee.* New York: HarperPerennial, 1992.

Fouts, Roger. *Next of Kin.* New York: William Morrow, 1997.

Galdikas, Biruté M. F. *Reflections of Eden: My Life with the Orangutans of Borneo.* London: Victor Gollancz, 1995.

Gallup, G. G., Jr. "Chimpanzees: Self-recognition." *Science* 167 (1970): 86-87.

Gibson, Kathleen Rita. "New perspectives on instincts and intelligence: Brain size and the emergence of hierarchical mental constructional skills." In *"Language" and Intelligence in Monkeys and Apes: Comparative Developmental Perspectives*, ed. by Sue Taylor Parker and Kathleen Rita Gibson, 97-138. Cambridge: Cambridge University Press, 1990.

Goodall, Jane van Lawick. *In the Shadow of Man.* Boston: Houghton Mifflin, 1971.

_____. *The Chimpanzees of Gombe.* Cambridge, Mass.: The Belknap Press of Harvard University Press, 1986.

_____. *Through a Window: Thirty Years with the Chimpanzees of Gombe.* London: Penguin, 1990.

Gorringe, Timothy J. *Capital and the Kingdom: Theological Ethics and Economic Order.* Maryknoll, N.Y.: SPCK/Orbis, 1994.

Griffin, Donald R. *The Question of Animal Awareness: Evolutionary Continuity of Mental Experience.* New York: Rockefeller University Press, 1981.

_____. *Animal Minds.* Chicago: University of Chicago Press, 1992.

Habgood, John. "A Sacramental Approach to Environmental Issues." In *Liberating Life: Contemporary Approaches to Ecological*

Theology, ed. by Charles Birch, William Eakin, and Jay B. McDaniel, 46-53. Maryknoll, NY: Orbis, 1990.

Hood, Robert. *Begrimed and Black: Christian Traditions on Blacks and Blackness.* Minneapolis: Fortress, 1994.

Kaufman, Gordon D. *In Face of Mystery: A Constructive Theology.* Cambridge, Mass.: Harvard University Press, 1993.

_____. *God, Mystery, Diversity: Christian Theology in a Pluralistic World.* Minneapolis: Augsburg Fortress, 1996.

Küng, Hans. *On Being A Christian.* Trans. Edward Quinn. New York: Doubleday, 1974.

_____. *Does God Exist: An Answer for Today.* Trans. Edward Quinn. New York: Vintage, 1981.

_____. *Christianity and the World Religions: Paths of Dialogue with Islam, Hinduism, and Buddhism.* Trans. Peter Heinegg. London: Doubleday, 1986.

_____ and Karl-Josef Kuschel. *A Global Ethic: The Declaration of the Parliament of the World Religions.* Preface and commentary trans. John Bowden. London: SCM Press 1993.

Lecky, William Edward Hartpole. *History of European Morals: From Augustus to Charlemagne.* 2 vols. 6th edn, revised. London: Longman's Green, 1884.

Lederer, Susan E. *Subjected to Science: Human Experimentation in America Before the Second World War.* Baltimore: John Hopkins University Press, 1997.

Linzey, Andrew. *Animal Theology.* London: SCM Press; and Chicago: University of Illinois, 1994.

Marten, K., and S. Psarakos. "Evidence of self-awareness in the bottlenose dolphin (Tursiops truncatus)." In *Self-Awareness in Animals and Humans: Developmental Perspectives*, ed. by Sue Taylor Parker, Robert W. Mitchell, and Maria Boccia, 361-179. Cambridge: Cambridge University Press, 1994.

Moltmann, Jürgen. *God in Creation: An Ecological Doctrine of Creation.* London: SCM, 1985.

Monod, Jacques. *Chance and Necessity: An Essay on the Natural Philosophy of Modern Biology.* Trans. Austryn Wainhouse. New York: A. A. Knopf, 1971.

National Research Council/ILAR Committee on Long-term Care of Chimpanzees. *Chimpanzees in Research: Strategies for Their Ethical Care, Management, and Use.* Washington, D.C.: National Academy Press, 1997.

Paley, William. *Principles of Moral and Political Philosophy.* 7th ed. Philadelphia: Dobson, 1788.

Pannenberg, Wolfhart. *Anthropology in Theological Perspective.* Trans. Matthew J. O'Connell. Philadelphia: Westminster, 1985.

_____. *Toward a Theology of Nature: Essays on Science and Faith.* Ed. Ted Peters. Louisville: Westminster/John Knox Press, 1993.

Passmore, John. "Attitudes to Nature." In *Environmental Ethics*, ed. by Robert Elliot, 127-141. Oxford: Oxford University Press, 1995.

Payne, Katharine B., William R. Langbauer, and Elizabeth M. Thomas, Elizabeth M. "Infrasonic calls of the Asian Elephant (Elephas Maximus)." *Behavioral Ecology and Sociobiology*, 18 (1986): 297-301.

Payne, Roger. *Among Whales.* New York, London: Scribner, 1995.

Peacocke, Arthur. *Theology for a Scientific Age.* Enlarged Edition. Minneapolis: Fortress, 1993.

Peters, Ted. "Introduction." In *Toward a Theology of Nature: Essays on Science and Faith*, by Wolfhart Pannenberg, 1-14. Ed. Ted Peters. Louisville: Westminster/John Knox Press, 1993.

Polkinghorne, John. *Science and Theology: An Introduction.* Minneapolis: Fortress Press, 1998.

Radner, D., and M. Radner. *Animal Consciousness.* Buffalo, N.Y.: Prometheus, 1989.

Regan, Tom, ed. *Animal Sacrifices: Religious Perspectives on the Use of Animals in Science.* Philadelphia: Temple University Press, 1986.

Rollin, Bernard E. *The Unheeded Cry: Animal Consciousness, Animal Pain and Science.* Oxford: Oxford University Press,1989

Savage-Rumbaugh, Sue, and Roger Lewin. *Kanzi: The Ape at the Brink of the Human Mind.* New York: John Wiley & Sons, 1994.

Schmithausen, Lambert. *The Problem of the Sentience of Plants in Earliest Buddhism.* Tokyo: The International Institute for Buddhist Studies, 1991.

Serpell, James. *In the Company of Animals: A Study in Human-Animal Relationships.* Revised ed. Cambridge: Cambridge University Press, 1996.

Sibley, C. G., and J. E. Ahlquist. "The phylogeny of the hominoid primates, as indicated by DNA-DNA hybridization." *Journal of Molecular Evolution,* 20 (1984): 2-15.

Singer, P. *The Expanding Circle: Ethics and Sociobiology.* Oxford: Clarendon, 1981.

Smart, Ninian. *The Religious Experience of Mankind.* 2nd ed. New York: Charles Scribner's Sons, 1976.

Sorabji, Richard. *Animal Minds and Human Morals: The Origins of the Western Debate.* Ithaca, New York: Cornell University Press, 1993.

Swimme, Brian. *The Hidden Heart.* Maryknoll, N.Y.: Orbis, 1996.

_____. *The Universe is a Green Dragon.* Santa Fe, N.M.: Bear, 1984.

_____ and Thomas Berry. *The Universe Story: From the Primordial Flaring Forth to the Ecozoic Era–A Celebration of the Unfolding of the Cosmos.* New York: HarperSanFrancisco, 1992.

Waldau, Paul. "Beyond Praise of the 'Declaration of the Parliament of World Religions.'" *Studies in Interreligious Dialogue,* 5 (1995): 76-89.

_____. "Interfaith Dialogue Needs an Inclusive Global Ethic." *World Faiths Encounter,* 11 (1995): 58-65.

_____. "Shortcomings in Isolated Traditions of Ethical Discourse: The Case of Andrew Linzey's Animal Theology." *Between the Species* 12, no. 3 & 4 (summer-fall 1996): 105-10.

_____. "On Breadth and Exclusion in Concepts of Nonviolence." *Philosophy East and West* 50, no. 3 (July 2000): 468-71.

_____. "The Question of Nonviolence in Hinduism and Other Traditions." *International Journal of Hindu Studies* 3 (1999).

_____. "On Peace and the Extent of Community." *The Journal of Buddhist Ethics* 6 (1999): 223-27.

_____. "Will the Heavens Fall? De-Radicalizing the Precedent-Breaking Decision." *Animal Law* 7 (2001): 75-118.

_____. "Buddhism and Animals Rights." In *Contemporary Buddhist Ethics,* ed. by Damien Keown, 81-112. The Curzon Critical Studies in Buddhism Series. Richmond, Surrey, England: Curzon Press, 2000.

White, Lynn. Jr. "The Historic Roots of Our Ecologic Crisis." *Science* 155 (1967): 1203-7.

Wilson, E. O. *Biophilia.* Cambridge, Mass.: Harvard University Press, 1984.

Wise, Steven M. *Rattling the Cage: Toward Legal Rights for Animals.* Cambridge, Mass.: Merloyd Lawrence/Perseus, 2000.

Wrangham, Richard W., et al., eds. *Chimpanzee Cultures.* Cambridge, Mass.: Harvard University Press, 1994.

Endnotes:

1. See, for example, *Politics* I, 5, 1254b20-21.

2. Consider, for example, the support given by John Locke, who otherwise advanced the cause of natural rights, for slavery under the constitution of South Carolina. See Hood, pp. 147 and 188.

3. There is rich, scholarly work on racism in the western tradition; see Hood, for example. The patriarchy materials are profoundly developed and plentiful. On classism, see the insightful work of Gorringe. On homophobia in some portions of the Christian tradition, see Bawer and Bruce.

4. These three terms are in quotes because the subject matter each raises is, upon examination, extremely complex. There are many theological traditions, and they are extraordinarily diverse. The comments in this article are directed toward what may generally be called the mainline Christian theological tradition. Science, too, is far from monolithic; it is, rather, an ever growing forest of sciences and subdisciplines. The word "animals" is, in ordinary discourse, used primarily to mean "all animals other than human beings," because even though human beings are known to be animals, daily discourse is allowed to work as if they are radically distinct from other animals. Although the phrase "humans and animals" is pervasive and influential, I intentionally avoid this unscientific and illogical practice for the agenda-driven purpose of suggesting that the biological community can be thought of holistically and without harsh, tradition-driven dualisms.

5. See, respectively, Monod, and Dawkins. Of the theologians and scientists mentioned in this article, Kaufman, Peacocke, Polkinghorne, and Barbour mention Monod and Dawkins in the works discussed here.

6. I first heard this term used by Peter Singer, now of Princeton University, in an August 1994 meeting at The Hague.

7. A foregrounding of ethical concerns is so typical of religious traditions that the comparativist Ninian Smart, when creating categories for approaching religious traditions, includes the category "ethical" as one of the six principal dimensions of religious traditions. See Smart, for example. The other categories are ritual, mythology, doctrine, and the social and experiential dimensions of life.

8. *Catechism of the Catholic Church*, § 2415.

9. The most debated statement along these lines is White's essay, "The Historic Roots of Our Ecologic Crisis." White argues that the Christian tradition's anthropocentrism was a principal factor in the origin and support of instrumental attitudes toward nature as a whole. While White's analysis has been forcefully challenged in many different ways as to its accuracy, on the distinct issue of the Western tradition's ethical anthropocentrism relative to nonhuman animals, the thrust of his thesis remains largely unrebutted. Similar points regarding the orientation of various religious traditions to ethical issues involving nonhuman animals are made in my reviews of *Subverting Hatred: The Challenge of Nonviolence in Religious Traditions.* See "On Breadth and Exclusion in Concepts of Nonviolence," "The Question of Nonviolence in Hinduism and Other Traditions," and "On Peace and the Extent of Community."

10. An argument for the "natural" qualities of such questions can be found in Wilson.

11. The classic argument for the expanded circle thesis is Lecky. See also Singer.

12. See Waldau, "Will the Heavens Fall?"

13. The most complete set of discussions in this area is, without doubt, the "Religion and Ecology" series at Harvard University's Center for the Study of World Religions directed, by Mary Evelyn Tucker and John Grim from 1997-1999.

14. See, for example, Waldau, "Beyond Praise of the 'Declaration of the Parliament of World Religions.'"

15. There is also virtually no engagement with the ancient, non-scientific traditions that have much to offer about specific nonhuman animals.

16. Quoted by John Passmore, p. 134.

17. For an account, see Rollin, especially pp. 67-75 and 97-106.

18. Consider that primatologists now routinely use the word "culture" for chimpanzee learning traditions. See, for example, Wrangham et al.

19. What, for example, is the actual impact of captivity upon eminently social animals like gorillas, dolphins, or elephants? Is this something a moral agent should care about? Would exposure to elephant individuals in their families suggest more than would intimate familiarity with all that has been said about elephants in, say, European, or Asian or African, languages?

20. Diamond.

21. I am indebted to John Hick for this quotation, cited in Chatterjee, p. 73. The original quotatation is from Desai, pp. 111-12.

22. Note that the claim here is that the Abrahamic traditions are ethically anthropocentric. Some claim that these traditions are theocentric. Whether or not one subscribes to this term as helpful, the fact remains that in ethical matters, most of those who claim that theocentrism is a valuable concept remain overwhelmingly anthropocentric when answering the question "Who are the others?" (That is, human beings are the animals who get the most fundamental protections when human interests are at stake.) One noteworthy exception is the work of Andrew Linzey. See, for example, *Animal Theology*.

23. There are important qualifications, since domestication of animals was, and still is, widely practiced in a way that involves extremely harsh realities. For example, regarding elephants, see Waldau, "Buddhism and Animals Rights." Generally, however, the injunction not to kill is very inclusivist.

24. One risk to foreground here is what philosophers like to call "the naturalistic fallacy." This occurs when, solely on the basis of some fact, someone contends that moral agents ought to do so and so. But here that problem is avoided, since I have assumed something beyond the mere fact of these complex nonhuman animals' existence. I have also assumed that human beings have the profoundly important ability to care about, recognize as distinct individuals, and then interact with these other, nonhuman animals as beneficiaries or moral equals—that is, as individuals deserving the basic moral protections human beings offer to those they consider within their "moral circle." So, the question becomes this: If human beings are both (1) moral agents and (2) capable of caring about these other animals (that is, they include them in their moral circle), ought they to do so?

25. I refer here to the well-known fact that many indigenous peoples lived in respectful relation to the nonhuman animals in their econiche. For a contemporary example of ethics-driven reasoning in favor of human caring about some nonhuman animals, see Cavalieri and Singer. Note also that caring about some nonhuman animals cannot automatically be equated with knowing and caring about each and every living being, as the latter is not feasible given that human beings are not able to recognize some nonhuman organisms as individuals.

26. Pannenberg, *Anthropology*, p. 61.

27. Ibid., p.62, n. 54.

28. Ibid., pp. 352-53.

29. The respected classicist Richard Sorabji, in *Animals Minds and Human Morals*, describes the vibrant debate among classical Greeks and Greco-Roman thinkers. He argues that Augustine effectively shut down the debate by siding with the Stoics in their denial of nonhuman animals' cognitive abilities and, thus, their moral significance.

30. Regarding values that appear during scientific work, there is the important distinction between (1) science being driven by various avoidable agendas, and (2) all science inevitably having unavoidably value- and theory-laden features (for a detailed discussion of the latter, see Barbour, pp.106-110). Both features are the subject of a substantial body of work, including sophisticated critiques from, among others, feminists, animal rights advocates, and environmentalists.

31. It was discovered in the mid-1980s that human beings and chimpanzees are extraordinarily similar in terms of genetic material. This was first reported by Sibley and Ahlquist. The figures usually given are 98.4% for human/chimpanzee similarity, and 97.7% for human/gorilla similarity. Subsequent work has suggested that the similarity in the active parts of the genetic coding mechanism is over 99%.

32. Pannenberg, op. cit., p. 32.

33. See, for example, Goodall, *In the Shadow of Man*; *The Chimpanzees of Gombe*; and *Through a Window*. A good sampling of contemporary literature can be found in a recent work calling for the extension of legal rights to two nonhuman great ape species (bonobos and chimpanzees); see Wise.

34. See Gallup, for example.

35. A good summary appears in Payne, ch. 4.

36. Reported in, respectively, Payne, Langbauer and Thomas; Marten and Psarakos; and Parker, Mitchell, and Boccia.

37. Pannemberg, *Toward a Theology of Nature*, p. 49.

38. Ibid., p. 32.

39. This is Pannenberg's description in *Toward a Theology of Nature*, p. 50.

40. Gibson, p. 97.

41. Pannenberg, op cit., p. 49.

42. Ibid., for example, pp. 45-49, where Pannenberg shows familiarity with some evolutionary thinking; or in *Anthropology* (see, for example, pages 142-3 and 354-6), where he addresses various features of the ethology work of Konrad Lorenz.

43. Ibid., p. 139.

44. At the time Pannenberg included this claim in his 1993 work, there was extraordinarily detailed information available regarding consciousness, self-consciousness, and self-awareness in some nonhuman animals. See, for example, Griffin's books, *The Question of Animal Awareness*, and *Animal Minds*.

45. Griffin, *Animal Minds*, p. 249, and generally, pp. 245-252; see also Byrne.

46. Peters, p. 1.

47. For example, a similar analysis could be made of Jürgen Moltmann's work, such as his 1984-5 Gifford Lectures, *God in Creation*. Hans Küng's many works also reflect this same set of problems. See, for example, *On Being A Christian*, trans. by Edward Quinn (New York: Doubleday), 1974; *Does God Exist? An Answer for Today*, trans. by Edward Quinn (New York: Vintage), 1981; *Christianity and the World Religions: Paths of Dialogue with Islam, Hinduism, and Buddhism*, trans. by Peter Heinegg (London: Doubleday), 1986.

48. Küng and Kuschel, pp. 101, 107.

49. See Waldau, "Beyond Praise."

50. Kaufman, *In the Face of Mystery*, p. 19.

51. Ibid., p. 12.

52. Darwin remarked that he had collected over twenty claims regarding uniqueness of humans, "but they are almost worthless, as their wide difference and number prove the difficulty, if not the impossibility, of the attempt." Quoted in Radner and Radner, p. 8. Gorringe makes very interesting comments on the ways in which elitist groups have used the notions of human nature and natural law to advance their own agendas.

53. See Waldau, "Buddhism and Animals Rights."

54. Regarding Kaufman's thoughts on human continuity with the "lower animals," see pp. 146, 163f, 203, 230f.

55. Ibid., p. 24, note 9.

56. Summarized well in Wise.

57. Kaufman, op. cit., p.146.

58. Ibid.

59. See Byrne, passim, especially pp. 124-44. Both anecdotal and systematic evidence is available in Fouts; Savage-Rumbaugh and Lewin; and Cavalieri and Singer.

60. Clutton-Brock, and Serpell

61. Kaufman, op. cit., pp. 163-64.

62. Kaufman's book, *God, Mystery, Diversity*, provides another insight into risks taken when using the God/humankind/world trilogy. The diversity and pluralism on which

Kaufman focuses is entirely human. Yet these very concepts, and especially the intuitions and critiques advanced by interfaith dialogue regarding the shortcomings of exclusivist tendencies, translate readily into insights about the exclusion of nonhuman realities. Further, how inclusivist can interfaith dialogue be if it excludes the nonhuman world so richly recognized outside the Abrahamic traditions?

63. The most developed theological thinking regarding nonhuman animals is that of Andrew Linzey, best exemplified in *Animal Theology*.

64. Aristotle, *Metaphysics*, I, 980a22.

65. Schmithausen, p. 95.

66. For information as to how *auctores* (literally, "originators") in the Hellenistic world, and then later, passed along inherited views, rather than a commitment to empirical investigation, as the criterion regarding nonhuman animals, see *Bestiary*, pp. 7-8.

67. See, for example, the detailed chart in Peacocke, pp. 216-17, and the heavy emphasis on cognitive sciences on pp. 223-36.

68. Ibid., pp. 226-27.

69. Ibid., pp. 7-8.

70. Ibid., pp. 221-22.

71. This distinguished scholar has a very interesting set of vocabularies for this topic. While he uses the word "animal" in ways that acknowledge that human beings are animals (for example, Barbour, p. 58), the overwhelming tendency is to use the term as a reference to all nonhuman animals (as at pp. 58, 59, 60, 74, 254-5, 259, 270, 278, and 280). A similar discourse habit appears (at p. 60, for example) when primates are discussed: "between humans and the highest apes." What makes this odd is that human beings are, scientifically speaking, members of the ape family. At p. 74, when Barbour talks of the "the similarities between humans and animals," he seems fully comfortable with this artificial division as if it was part of nature, or a helpful description because it is reflective of the order of things.

72. Ibid., p. 259.

73. Ibid., p. 270.

74. William Paley noted at the end of the eighteenth century, "Nothing is so soon made as a maxim; and it appears from the example of Aristotle, that authority and convenience, education, prejudice, and general practice, have no small share in the making of them; and that the laws of custom are very apt to be mistaken for the order of nature." (Paley, p. 32.) Paley was discussing Aristotle's view of non-Greeks as slaves.

75. Polkinghorne, p. 49.

76. Ibid., pp. 9ff.

77. See, for example, Linzey's analysis (chapter 4) of liberation theology's shortcomings regarding nonhuman animals.

78. See, for example, Waldau, "Shortcomings in Isolated Traditions of Ethical Discourse."

79. Berry, *The Dream of the Earth*, and *The Great Work*.

80. See, for example, Swimme's *The Hidden Heart*. At p. 50, Swimme speculates, "If an orangutan could speak, it too would regard the stars as far above, up in the sky; if it were lying on its back on a field of grass at night, it too would think it was looking up at the stars." The point here is not the accuracy of the statements, but the willingness to get beyond the standard dimissals of all nonhuman animals. On the extraordinary intelligence and other abilities of orangutans specifically, see Galdikas, and Cavalieri and Singer. For more on Swimme's thought, see *The Universe is a Green Dragon*, and Swimme's joint effort with Berry, *The Universe Story*. In the latter, there are abundant references to many different animals and plants, as well as references to the more mentally complex nonhuman animals: at p. 144, the text mentions the gibbon, chimpanzee, orangutan, gorilla; and at p. 272, the timeline mentions many animals, including whales, apes, cats, dogs.

81. Views from different religious traditions are discussed in Regan.

82. As always, qualifications are important. There have been, and continue to be, human subjects in biomedical experiments. See Lederer, for example. In addition, some non-

human animals have been exempted from the harshest features of experimental realities. Britain and New Zealand have had, respectively, administrative and legislative bans since the late 1990s; while in the U.S., there are less extensive limitations. See, for example, National Research Council/ILAR Committee on Long-term Care of Chimpanzees.

83. *Catechism*, p. 516.

84. Quoted in Blum, p. 137.

85. Ibid., p. 78.

86. See, for example, Linzey; and Habgood, pp. 47-52.

87. See, for example, Callicott and Ames, pp. 17-21.

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Chaos Theology: A New Creation Theology and Its Applications

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The problems inherent in creatio ex nihilo *have led the author to the development of a new creation theology: chaos theology. Its main points are creation from an unexplained initial chaos, a remaining chaos element that is the source of physical and moral evil, and continuing creation toward fulfilment on the Last Day. Chaos theology can be reconciled with the scientific account of cosmic and biological evolution. Combining chaos theology with the physical theory of chaos helps in the understanding of God's action in the world. Jesus Christ is shown to be the cosmic Christ, who reconciles the entire cosmos, not only humanity. The problem of evil is readily solved in chaos theology as the effect of the remaining chaos element. From chaos theology and scientific insight in cancer, a theology of illness can be derived.*

A. From *creatio ex nihilo* to chaos theology

How can creation be reconciled with evolution? What can be said about God after Auschwitz? What can be said about original sin and predestination? Is illness God's punishment for sin? These questions I shall consider in the light of a new creation theology, which I call chaos theology and which I wish to replace the traditional doctrine of creation from nothing (*creatio ex nihilo*).[1]

1. Origin of creatio ex nihilo

The two creation stories in Genesis 1 and 2 both pose an initial chaos: a lifeless desert in the older story (Gen 2:5-6), a formless void, darkness, waters in the later story (Gen 1:2). The Hebrew term is *tohu wabohu*, which is also used in Isaiah 34:10 and Jer 4:23 for chaos, waste and void. The early Fathers Justin (c. 150) and Clement of Alexandria (c. 200) retained this view. Clement points to a passage in the Wisdom of Solomon, "For your all-powerful hand, which created the world out of formless matter..." (Wis 11:17), and applied the Neoplatonist idea that the ultimate divine reality in creation overflows into the surrounding void. Creation from initial chaos is also the common view in non-biblical creation stories. In the few that use the term "nothing," this only refers to the initial absence of structures and beings seen in the present world. The idea of an initial chaos might thus be considered a Jungian archetype.

When and how did this view come to be replaced by the idea of creation out of nothing (*creatio ex nihilo*)? This happened around 185 CE, when Theophilus of Antioch invented *creatio ex nihilo* in his battle against Marcion and the Christian Gnostics. Noticing the evil in the world, the latter taught that the universe was created by a demiurge, a lower imperfect god, using evil pre-existent and eternal matter.[2] Theophilus (c. 185) rejected both, saying, "It would be nothing great if God had made the cosmos out of pre-existent matter."[3] Irenaeus (c. 190) agreed with Theophilus; he opposed the gnostic belief in a plurality of divine beings by upholding the one true God of the Hebrew and Christian Scriptures, and the idea of pre-existing and eternal matter by claiming that God took from the divine self the matter for creating all things. This matter meant, for Irenaeus, God's will and power. Cosmological questions scarcely worried him:

> As the Bible gives no information, it is not permissible to speculate about it as the Gnostics do.[4]

Later, Augustine (c. 400) accepted the *creatio ex nihilo* idea, which was thereafter almost universally adopted by the Church. It was dogmatically formulated at the Fourth Lateran Council (1215), adopted by the reformers Luther and Calvin, and reaffirmed by the first Vatican Council (1870). Thus, *creatio ex nihilo* was universally accepted and never again rejected. However, true "nothing" poses several problems.

2. Problems with creatio ex nihilo

The concept of *creatio ex nihilo* presents four serious problems: conceptual, biblical, scientific, and theological.

Conceptual. No one can picture absolute nothingness, which may explain why many philosophers and theologians, among them Plato, Heidegger, Augustine, and Barth,[5] employ the term *nihil* in a rather loose fashion. They consider it as a *nihil ontologicum*, an existing nothing, rather than a *nihil negativum*, absolute nothing. However, an existing *nihil* is not essentially different from an initial chaos. The same is true, if one says, with John Polkinghorne, that *creatio ex nihilo* is merely a "metaphysical" statement.[6] Therefore, I shall adhere to a strict interpretation of *nihil* as the complete absence of matter, energy, physical laws, structure, and order.

Biblical. As I have said above, *creatio ex nihilo* conflicts with both of the creation accounts in Genesis. Claus Westermann writes in his authoritative commentary on Genesis 1-11:

> Such an abstract idea is foreign to both the language and thought of P [the unknown author of Gen 1]; it is clear that there can be here no question of a *creatio ex nihilo*; our query about the origin of matter is not answered; the idea of an initial chaos goes back to mythical and premythical thinking.[7]

The four texts commonly cited in support of *creatio ex nihilo* are as follows:

> God stretches out Zaphon [or *the North*] over the void, and hangs the earth upon nothing. (Job 26:7)

> ...God...who...calls into existence the things that do not exist. (Rom 4:17)

> ...what is seen was made from things that are not visible. (Heb 11:3)

> ...look at the heaven and the earth and see everything that is in them, and recognize that God did not make them out of things that existed.
> (2 Macc 7:28)

These texts fit equally well with creation from initial chaos, and thus can hardly be seen as clear evidence for creation *ex nihilo*. The *ex nihilo* concept is foreign to the Bible, which conclusion is also reached by Scottish theologian David Fergusson.[8]

Scientific. In an extensive study, *God, Creation and Contemporary Physics*, Australian theologian Mark Worthing concludes:

> Neither classical, quantum mechanical or relativistic physics can explain the origin of the universe from nothing. Any theory explaining how something has come from nothing must assume some preexisting laws or energy or quantum activity in order to have a credible theory. Nothing comes out of nothing.[9]

Some physicists like to describe the cosmic origin as a "quantum fluctuation in a vacuum," but this does not constitute an initial *nihil*. Here are the words of physicist-theologian John Polkinghorne on the subject:

> A quantum vacuum is a hive of activity, full of fluctuations, of random comings-to-be and fadings-away, certainly not something which without great abuse of language could be called "nothing."[10]

Arthur Peacocke appears to agree when he writes, "It was not just 'nothing at all' even if it was 'no thing'!"[11] The ironic fact is that if science could explain a beginning of the world from a *nihil*, then there would be no place left for a Creator.

Theological. Explaining a cosmic origin from true *nihil* causes theologians as much of a problem as it does scientists. Karl Barth[12] tries to reconcile the initial chaos of Gen*esis* 1:2 with "nothing" by assuming a *nihil privativum*, which he calls *das Nichtige*, a "nothing" of things already existing, but not real before they were created. Emil Brunner basically abandons *creatio ex nihilo* when stating, "There never was a 'nothing' alongside of God," and the meaning of the biblical words "create" and "creation" is that...

> God alone creates the world with no other co-operating factor; this expresses something which is utterly beyond all human understanding. What we know as creation is never "*creatio ex nihilo,*" it is always the shaping of some given material. [13]

However, as I said above, an existing *nihil* is not essentially different from an initial chaos. Paul Tillich realizes this, when he states, "The *nihil* out of which God creates is...the undialectical negation of being." [14] Mark Worthing states that creation out of absolute nothingness is an impossibility. He also rejects a creation out of God's own "substance" as leading to a pantheistic deification of the physical world, but seems to come close to this in his final conclusion:

> *Creatio ex nihilo*, therefore, signifies the theological recognition that God created a universe distinct from the divine being, not out of any preexisting matter or principle, but out of nothing other than the fullness of God's own being.[15]

In his recent book, Oxford theologian Keith Ward[16] has a section entitled "creation out of nothing," in which he rightly distinguishes between "origin" in the cosmological sense and "creation" in the theological sense and argues the case for a created universe. But he does not discuss, much less explain, the *creatio ex nihilo* concept.

The key of the chaos theology is that I assume that the remaining element of chaos expresses itself in the evil in the world, both physical evil (natural disasters and illness) and moral evil (committed by human beings).

Jürgen Moltmann has made a serious attempt to provide a theological explanation for a true *creatio ex nihilo.* The first problem to be solved, he notes, is where to locate an initial "nothingness." Initially, "it" must be inside God, so as not to limit God's omnipresence; but for creation, "it" must be externalized to avoid pantheistic deification of the created world. He tries to formulate this process by invoking *zimsum* and *shekinah* (both from the Jewish *kabbala*), *kenosis* and God's self-humiliation, and concludes:

> The initial self-limitation of God, which permits creation, assumes the glorious, unrestricted boundlessness in which the whole creation is transfigured. [...] The death of Christ overcomes the annihilating nothingness, which persists in sin and death.[17]

I agree with David Fergusson,[18] who finds this "ultimately unconvincing." I would add that a nothingness that annihilates cannot be true "nothing," and then we are back to an initial chaos. Since that is the biblical concept, I prefer to start from there.

3. Principles of chaos theology

In both Genesis stories, God is first, not created. God is before the "beginning," is timeless. This is a marked difference from the Babylonian creation story, *Enuma elish.*[19] In Genesis 1 God pushes back chaos in three separations (vss 2-10) and orders chaos by creating heavenly bodies, plants, animals, and human beings. Numerous texts in the Hebrew Bible suggest that an element of chaos remains, frequently symbolized as "sea" (as desert people, the Israelites were afraid of the sea). God assigns boundaries to the primeval sea (Job 38:8-11; Ps 104:7-9; Prov 8:27-31; Jer 5:22), sets a guard over the sea (Job 7:12), orders the waters back (Ps 18:15; Ps 89:9), and stills the raging of the sea (Ps 65:7; Nah 1:4). A text in the New Testament book of Revelation implies that on the Last Day this element of chaos will be abolished:

> Then I saw a new heaven and a new earth; ...and the sea was no more.
> (Rev 21:1)

The remaining element of chaos finds a parallel in primitive religion in the widespread and prominent distinction between the sacred and the profane.[20]

The key of the chaos theology is that I assume that the remaining element of chaos expresses itself in the evil in the world, both physical evil (natural disasters and illness) and moral evil (committed by human beings).

The six days of creation, followed by a day of rest (Gen 2:2), suggest a continuation of the creation process (*creatio continua*) toward a transcendent goal, the destiny of creation.[21] The creation of which humankind is a part is not yet complete. God continues to work in the creation, battling remaining chaos, bringing it to fulfilment (not to destruction and replacement) on the Last Day. In the repeated phrase, "God saw that it was good (e.g., Gen 1:10), the Hebrew word *tov* does not mean good in actuality, but good for the purpose. The incarnation of God's creative Word in the earthly human Jesus of Nazareth, is the decisive event in God's battle against chaos. Evil is not created (as required in *creatio ex nihilo*, resulting in the never-solved theodicy; see section C below), but it is the expression of remaining chaos. Thus, chaos theology provides a comprehensive creation theology that stretches from initial creation till the Last Day and includes the person and work of Jesus Christ.

Now I consider some critical questions that may be raised:

Can one abandon the doctrine of *creatio ex nihilo*, which has been nearly universally held since the third century? As an Anglican, I hold to the Anglican "tripos" of Bible, Tradition (as expressed in the ancient creeds) and Reason (with which to consider the first two). I have shown that *creatio ex nihilo* is not biblical, and it is not contained in the ancient creeds. It is, thus, part of the ongoing tradition of the Church, which is not unchangeable.

Does creation from initial chaos re-introduce gnostic dualism? Acceptance of the biblical idea of creation from chaos does not introduce gnostic dualism, as long as one does not invoke a demiurge but maintains with Gen*esis* 1 the absolute sovereignty of God who creates by his authoritative Word. The dualism between order and chaos is, like that between good and evil, light and dark, belief and unbelief, particle and wave, simply the recognition of a property of the universe in which we exist.

Does the idea of God battling remaining chaos diminish God's omnipotence? Bearing in mind that omnipotence is a vague speculative concept, I feel that a God who is battling remaining chaos till the final victory on the Last Day is more powerful than a Creator who allows the initial creation to be spoiled by wayward humans, as Origen and Augustine claimed.

Who created initial choas, if not God? This is the type of question not to ask, because here one encounters the initial mystery. I shall come back to this in the next section. I am reminded of the story about Thomas Aquinas, who supposedly replied to the question of what God did before the Creation: "That is when God created hell for people who ask such questions."

How can evil come from chaos? Although I suggest that remaining chaos expresses itself in the evil in the world, I consider chaos itself as morally neutral. However, both human beings and nature are under its influence; and this may lead to moral and physical evil, e.g., "chaotic thinking" may lead humans to evil behavior. Paul seems to express this in Romans 7:15:

> I do not understand my own actions.
> For I do not do what I would, but I do
> the very thing that I hate.

A relationship between chaos and evil is expressed by the claim of psychotherapist-theologian Eugen Drewermann[22] that various types of psychiatric disease are caused by the fear of being thrown back into primordial chaos, of which he sees a remaining element in our world. And also below in section C-5, I claim that cancer is due to the reversal of cellular order into primordial chaos. On the other hand, chaos also has the potency for good. In God's freedom and creativity, God creates by ordering chaos. Likewise, human beings can to some extent order chaos through the use of their God-given freedom and creativity.

4. Chaos theology and the scientific worldview

In this section, I present some illustrations of the way in which chaos theology can contribute to the dialogue between the two worldviews of science and theology. The aim of such a dialogue is to determine to what extent the descriptions of the reality of the cosmos by each worldview in its own thought categories can be reconciled and integrated. In this way, a deeper understanding of this reality may be achieved, a faith to live by in these times.

The current scientific worldview is formed by Big-Bang cosmic evolution and biological evolution.

Initial mystery. In both worldviews, one faces an initial mystery: Genesis does not explain the initial chaos, lifeless desert (Gen 2:5-6), or watery void (Gen1:2). It does not say how it came about or what it consists of. Cosmological theory allows us to calculate back from the present state of the universe to a point 10^{-43} sec after time zero, the supposed moment of the Big Bang, but cannot say anything about conditions and origin of the initial state at time zero or before.

Separation. The three separations in Genesis 1 (light from dark; water from heaven; earth from sea) are paralleled by the three separations in cosmology: of time and space; of the four fundamental forces (gravity, strong and weak nuclear forces, electromagnetic force), and of the elementary particles (electrons, quarks and gluons, the latter two turning into protons and neutrons).

Ordering. In Genesis 1, the heavenly bodies are created early, corresponding to galaxies, stars and planets in the view of modern cosmology. After that, in both views, the plants, animals, and human beings—in that order—appear on planet Earth. Ignorance of photosynthesis made the author of Genesis 1 err only in having the sun appear after the plants.

Chaos and entropy. The second law of thermodynamics tells us that every closed system left to itself will in the course of time increase its entropy, a measure of disorder. Production of galaxies, stars, planets, and living organisms brings order, which means decreasing entropy. Is there a conflict? No: they are open systems, exchanging energy and matter with their surroundings.[23] Every animal on Earth receives energy from the sun, takes up material as food from its surroundings, and excretes waste products into it. So its entropy decreases, while that of the surroundings increase. Reversal of this process means death of the animal. This is the scientific way of expressing that creation is an ordering from initial chaos by pushing back chaos.

Information theory provides an equation for the relation between information content and entropy of the cosmos.[24] It shows that entropy is infinite and information content zero at time zero, representing initial chaos at the moment of the Big Bang. Thereafter, information content approaches infinity and entropy goes to zero, representing the end of evolution—or in theological terms, the establishment of the New Kingdom. An approaching end to human evolution is supported by the ever-decreasing evolutionary rate in the sequence: mouse, dog, monkey, ape, human being.[25] For human beings, it should eventually become zero, due to the elimination of natural selection for them, through medicine and technology.

Other analogies. The conclusion that time began with the Big Bang finds an analogy also in Augustine's statement that the universe was created "with" rather than "in" time. The cosmological insight that the universe has no center has a counterpart in the theological insight that God is everywhere and is not limited to one location. The fact that the entire cosmos was required to enable the emergence of human beings on planet Earth is reflected in the unique place assigned to humans in Genesis 1.

Notwithstanding these analogies between the creation story and the scientific account of cosmic and biological evolution, they should not be equated. The former answers why-questions about the relation between God, world, and humankind; the latter answers how-questions about the mechanisms. But the former can give a meaning and purpose to the process of cosmic and biological evolution, which science by its nature cannot provide and which is neglected in the "nothing but" and "chance only" ideology of some non-believing scientists. The presence of evil in the created world, for which science cannot give a satisfactory explanation, can be explained as the result of the operation of the remaining element of chaos in creation.

B. God's Action in the World

How does God act in the world? The answer to this question has been largely determined by the dominant scientific worldview of the time. The discovery of the laws of gravity and motion by Isaac Newton (1642-1727) led to a mechanistic worldview: once created, the universe would run a predictable course according to fixed laws. This led to a deistic view of the Creator, who after one act of creation left the world to develop by itself according to unalterable laws. In the early twentieth century, quantum theory with Heisenberg's uncertainty principle made Newtonian certainty turn into quantum mechanical probability and Heisenbergian uncertainty, with waves behaving like particles and vice versa. However, quantum events operate only at the microlevel of atoms and cannot be amplified to the macrolevel of our daily life. Since the 1970s, another kind of unpredictability has been discovered in the chaos events that occur in many physical, chemical, and biological systems and, thus, operate at the macrolevel of our daily life.

> ***Evil is not created, as required in* creatio ex nihilo*, resulting in the never-solved theodicy, but it is the expression of remaining chaos. Thus, chaos theology provides a comprehensive creation theology that stretches from initial creation till the Last Day and includes the person and work of Jesus Christ.***

1. Chaos events

In complexity theory, it is recognized that all living beings, and many other systems, are so-called non-linear systems. In the course of time, such systems meet a fork in the road.[26, 27] The system may then take either one of two directions. There is no energy difference between these, so they are equally likely. However, one cannot predict which direction the system will take: a chaos event occurs. As time proceeds, more forks are met. Eventually, the system becomes fully unpredictable. An example is the solar system. It has been calculated that in 93 million years from now the present uncertainty of 1 kilometer in the 150 million km distance between Sun and Earth will have increased to 150 million km.[28] In other words, at this time one cannot predict whether they will then collide or will be at double their present distance—or somewhere in between.

In such chaos events the most minute influence can nudge the system in one rather than in the other direction. This means that God can, when so choosing, intervene through the Spirit without violating any physical laws. And even prayer can exert influence; it reaches God through the Holy Spirit, and God can answer in a chaos event. Thus, in the current scientific worldview the universe is open and spontaneous, in which the theologian may see God's immanent and providential activity operating in chaos events.[29]

2. Contingency in theology and science

Contingency is a state of being dependent, endangered, accidental. Theologians have always recognized the contingency of the universe. Since it comes into being through the creative Word of God, this means that if God should withdraw the Word, the universe would lapse into "non-being," as Paul Tillich said, who held to *creatio ex nihilo*.[30] However, the physical law of conservation of mass/energy makes this impossible. In chaos theology, Tillich's "non-being" can be replaced by "chaos," a state of complete disorder. This fits with the conservation law, as well as with the second law of thermodynamics. It is also in agreement with the aforementioned statement by Eugen Drewermann that various types of psychiatric disease are caused by the fear of being thrown back into primordial chaos. All this indicates that the occurrence of contingency can be better explained by chaos theology than by *creatio ex nihilo*.

Science has begun to recognize contingency. In cosmology it is realized that the universe is extremely "accidental." Gribbin and Rees[31] speak of two cosmic coincidences:

• The universe appears to be "flat," meaning that the universe would be in the unlikely situation in which the expanding force of the initial explosion is exactly balanced by the gravitational force. The precision of this balance would have to be better than one part in 10^{60}, corresponding to the accuracy required to hit an inch-wide target at the other side of the observable universe.[32] Recent findings from the Boomerang balloon seem to confirm the flat universe.[33]

• The universe is "tailor-made" for humankind, meaning that the 25 fundamental constants have just the right values to have led to Earth and to the development of life and eventually human life on it.[34] Were the force of gravity only slightly weaker than it actually is, stars would have been too cool for nuclear fusion and the formation of heavier elements, so no Earth and no life would have formed. Were it just slightly stronger, the universe would have collapsed before life could have developed. Similar contingencies exist for the other 24 constants. Just the right set of values for these constants exists, which is an extremely unlikely situation. Physics cannot explain this. The "anthropic principles" of Barrow and Tipler[35] and the multi-world hypothesis of Gott[36] are unscientific explanations (being untestable). To me, it seems more reasonable to believe in a purposeful Creator than in anthropic principles or multiworld hypotheses.

In biological evolution there was th] fortuitous change in the oxygen content of the earth's atmosphere.[37] The initial oxygen-free atmosphere had the double advantage of allowing formation of biomolecules through the action of solar ultraviolet radiation (in the absence of an ozone layer), and protecting them from oxidation. When the first living cells had been formed, probably around hydrothermal vents in the ocean floor, algae developed and acquired a photosynthetic system. These algae converted carbon dioxide to oxygen, which led in 1.5 billion years to the present oxygen-rich atmosphere with an ozone layer. This allowed development of plants and animals that could go ashore. Other examples of contingency[38] include: the earth's strong magnetic field (800 times that of Mars) that diverts cosmic particle radiation; a massive planet at Jupiter's position that diverts asteroids; the extinction of dinosaurs 65 million years ago by an asteroid impact, which allowed mammalians to develop; the Rift Valley tectonic event that led to bipedalism and hominid development.

3. God transcendent and immanent

In the Newtonian era there was need only for a deistic God who set things in motion on a pre-ordained course, then withdrew from the world. The current scientific worldview requires a God who remains active in the evolving universe. But how? A god who merrily suspends the physical laws that were instituted in the beginning would be a disaster. The physical theory of chaos events appears to offer a solution, as I have explained above in the "Chaos events" section (B-1).

Continuing creation rather than conservation. A faulty translation of Gen*esis* 1:1-2 and a misunderstanding of the Hebrew word *tov* led to the idea of an initially perfect creation, later spoiled by Adam's fall. For the opening verses of Genesis, the King James Version has:

> In the beginning God created the heaven and the earth. And the earth was without form, and void....

In the New Revised Standard Version this is translated:

> In the beginning when God created the heavens and the earth, the earth was a formless void...

which places the chaos at the beginning. In the repeated phrase, "God saw that it was good" (e.g., Gen 1:10), the Hebrew word *tov* does not mean good in actuality, but good for the purpose God had in mind. Theophilus of Antioch had already described God's action in the world after the initial creation as "conservation," as keeping together a creation spoiled by human beings. This idea has persisted through the centuries, particularly in Calvinism. Conservation would imply that God keeps the damaged vehicle running until at the Last Day he must replace it by a new one. This underrates the Creator's power and overrates the human. It does not explain physical evil that was present before the arrival of humankind, and it does not take into account the process of cosmic and biological evolution that has been going on for 15 billion years. In light of all this, I prefer to hold onto the idea of a continuing creation after an initial creation that was good for the ultimate purpose of the Creator, to be fulfilled through the continuing creation.

God's transcendent and immanent activity. The distinction between initial and continuing creation leads me to the view that God is acting in two ways: transcendent and predictable; immanent and unpredictable (for human beings). God works predictably through natural laws, which are the human formulation of the orderliness of natural events as ordained by God in the initial Creation. In accordance with these laws, God creates and assures a reliable existence for all creatures. Here God is seen outside and above creation, as *transcendent*. In continuing creation, God works in complete creative freedom with action unpredictable to human beings, and the result is observed by them as "chance" and "chaos events," through which creation is guided through many contingencies to the destiny determined by God in the beginning. Within the ordered structure described by natural laws, God retains divine freedom in the creative use of "chaos events." Here God is seen as active within creation, battling the remaining chaos element. This I see as God's *immanent* activity, which is invisible to human beings except in hindsight, in the course of evolution and in the course of individual lives. God's immanent activity in chaos events implies that petitionary and intercessory prayers are meaningful: God can decide to honor them by influencing a chaos event.

4. Jesus Christ and reconciliation

Recently Dutch Calvinist theologian Cees den Heyer caused a stir in his church with his book about reconciliation.[39] After an extensive review of New Testament teaching on reconciliation, he admits in the last few pages that he can no longer accept traditional Calvinist teaching about reconciliation. He objects to the idea that God could be so entrapped in God's own justice as to require that the Son be killed to bring reconciliation. Unfortunately, den Heyer does not offer an alternative. I claim that three errors were made by Origen (200) and Augustine (400) with their ransom theory, by Anselm (1100) with his satisfaction theory, by Luther with his substitution theory, and by Calvin with his penal theory: 1) biblical metaphors were literalized; 2) crucifixion was isolated from incarnation and resurrection; and 3) continuing creation was neglected. On the matter of literalizing metaphors: a sign with the symbol for "exit," as found in European railway stations, is not itself the exit, but points to it; those who think that it is the actual exit will bump their heads.

A more satisfactory answer can be provided by chaos theology. In continuing creation, God has been involved in an ongoing battle with remaining chaos for 15 billion years already. *Homo sapiens* has existed only during the last 40,000 years. So this is not only a human predicament, but a cosmic drama. Paul senses this when he says:

> We know that the whole creation has been groaning in travail together until now. (Rom 8:22)

So in this ongoing battle, God is not redeeming merely humans, but the entire cosmos. Again, Paul glimpses this when he says,

> God was in Christ reconciling the world [Greek, *kosmos*] to himself. (2 Cor 5:19)

Our present understanding of the cosmic evolution can explain the idea of the cosmic Christ. The lightest chemical element, hydrogen, was formed in the Big Bang; in the nuclear fusion process in the stars, the heavier elements, such as carbon, nitrogen, and oxygen, were formed from hydrogen. When these stars exploded as supernovae, the chemical elements were ejected as cosmic dust, from which Earth and the other planets were formed. Living cells were formed from the elements of Earth, and so, eventually, were human beings. Jesus Christ, in adopting the human body, thus takes part in the entire universe: he becomes the cosmic Christ. God's "top" creatures, bearers of the divine image, have succumbed to the remaining chaos element and become sinners. Then chaos, in what one might anthropomorphically call "a last desperate effort," leads human beings to kill Jesus in the crucifixion, a judicial murder. However, God turns this apparent defeat around, against chaos and into a victory by the resurrection of Christ. This is an initial victory, which will become definitive at the Last Day, when God will forever banish the chaos element. It is the total action of Christ, rather than only his death, that brings reconciliation to the cosmos.

This theology of reconciliation avoids literalizing the biblical metaphors, integrates the crucifixion with incarnation and resurrection, gives reconciliation a cosmic dimension, and places it in God's continuing creation, leading to the fulfilment on the Last Day. God is not pictured as a captive of God's own justice. Crucial is our acceptance, in and through faith, of the reconciliation achieved in Jesus Christ; only then can we become inhabitants of the New Kingdom, which is creation fulfilled. Putting it very succinctly: Jesus died not *for* our sins, but *because of* our sins; salvation comes not from his death, but from his resurrection.

C. The Problem of Evil

Evil is a much discussed topic in our day. Through the modern means of mass communication the problem of evil looms larger than ever. There is the moral evil of horrible atrocities, captured under names like Auschwitz, Rwanda, Bosnia, Kosovo, Sierra Leone. Nearer home, unprovoked violence is seen in our streets, schools, and homes, as well as fraud and corruption by public figures. There is the physical evil of natural disasters in the form of earthquakes, volcanic eruptions, hurricanes, and floods, by which thousands of innocent people are killed, injured, or made homeless. Another form of physical evil human beings face is illness in themselves and in their loved ones. Even those who have distanced themselves from a belief in a personal God still blame God for the existence of evil. It seems to be their final thought about the God who is disappearing from their view. They repeat the questions of Epicurus (300 BCE):

> If God created the world, why is there evil? If God cannot do anything about it, why is God called omnipotent? If God is omnipotent and does not intervene, why is God called good?[40]

Introducing Satan as the agent of evil, does not help. If Satan is not controlled by God, then the evil demiurge of Gnosticism presents itself again. If Satan is controlled by God, as suggested in the book of Job, then God is ultimately responsible. Theodicy, the problem of evil in a world created by a good and almighty God has never been solved by the theologians. Even Pope John Paul II seems to admit this in his encyclical, *Fides et Ratio*.[41]
I submit that this is the inevitable consequence of the doctrine of *creatio ex nihilo*, creation from nothing.

1. *Evil in the context of* creatio ex nihilo

Several authors have reviewed the explanations that have been advanced for the problem of evil in *creatio ex nihilo* context. In *Evil and the God of Love*, John Hick[42] distinguishes the Augustinian and Irenaean models. The key points of the Augustinian model are as follows:

• the created world was perfect, so evil does not stem from God. (This is obviously wrong and a misinterpretation of the Hebrew word *tov*.)

• evil is the absence of good (*privatio boni*). (This does no justice to the reality of Auschwitz and similar large-scale horrors.)

• evil comes from human sin, the misuse of our freedom. (However, the doctrine of predestination still makes God responsible.)

• physical evil came because Adam's sin corrupted nature. (But natural disasters and disease preceded the appearance of humans. Dinosaurs already suffered from arthritis, as shown by study of their fossil remains.)

In continuing creation, God has been involved in an ongoing battle with remaining chaos for 15 billion years already. Human beings have existed only during the last 10,000 years. So this is not only a human predicament, but a cosmic drama.

The Irenaean model posits that evil ultimately exists within God's good purpose. God could have created differently, but knew that early humans were too immature to receive, contain, and retain perfection. My objection to this is that it upholds God's goodness, but compromises omnipotence. Schleiermacher goes even further by saying, "sin has been ordained by God, for otherwise, redemption itself could not have been ordained."[43] My objection is that this amounts to causing a shipwreck in order to allow the staging of a rescue operation. Neither of the two models offers much insight in physical evil.

Anton Houtepen,[44] a Dutch Roman Catholic theologian, reviews the positions of Greek philosophers, and of Augustine, Thomas Aquinas, Luther, Leibnitz, and Kant. In the end he reaches two conclusions: the question resounding in theodicy indicates an awareness in humans of the "possible good"; and the entire human activity of religion, art, science, and technology stems from this quest for the good.[46] These conclusions, right as they may be, do not offer a satisfactory explanation of theodicy. However, I do agree with his vigorous denunciation, based on a study of the story of Job, of the idea that the evil in the world is God's punishment for human sins.[47] Roman Catholic theologian Edward Schillebeeckx[47] denounces *creatio ex nihilo* as "clumsy words and images for expressing that God's work transcends our thinking." He relates evil to the finitude of all that is created, in the sense that the latter provides the possibility for evil to arise. In a private discussion with me,[48] he admitted that he has no explanation for evil.

Surprisingly, few contemporary theologians show any awareness of the evolutionary nature of creation. An exception is radical Calvinist theologian H. M. Kuitert, who in his book, *I Have My Doubts*, applies evolution in his discussion of theodicy, but concludes, "evolution is an unpredictable process: it has no purpose."[49] So he does not integrate it in his further discussion of "the riddle of the good creation." Since he still interprets "good" (*tov*) as indicating the quality of the present, unfinished creation, he encounters more problems and rejects more traditional explanations than he offers solutions for. His conclusions that "evil is part of life and we have to put up with it," and that "God can turn to good what human beings had thought to be evil," can hardly be considered to constitute a satisfactory solution of theodicy.

Mark Worthing considers theodicy in the context of contemporary physics.[50] He distinguishes a dysteleological model (evil lacks a purpose, and leads only to further disorder), and a teleological model (evil is part of a purposeful process and thus confined to certain established limits). He connects evil, both physical and moral evil, with the concept of entropy, the measure of disorder in a physical system. He bases this idea, in part, on Robert Russell,[51] who notes that entropy and evil are both "dependent on being and lack independent existence." Without order, disorder has no meaning or existence; similarly, without good, evil has no independent existence. Worthing sees here an analogy with the Irenaean idea that the good depends on the existence of a certain amount of evil in the world, which thus becomes a suitable place for soul-making. This idea he borrows from the poet John Keats, who wrote that we should not call this world a "vale of tears," but rather a "vale of soul-making," [52] where we grow spiritually through enduring the vicissitudes of life. However, it seems a travesty to claim that God permits evil in order to force or encourage spiritual growth. In the end, Worthing supports Philip Hefner's conclusion:

> Chaos is the womb of creativity....
> Creation and chaos belong together by nature.[53]

While this goes in the direction that I shall pursue in the next section, I conclude that *creatio ex nihilo* does not permit a satisfactory explanation for the problem of evil.

3. Evil in chaos theology

Chaos theology can provide a solution for the problem of evil. The remaining element of chaos expresses itself in the evil in the world, both physical (natural disasters and illness) and moral (human evil). While physical evil is simply the consequence of the presence of the chaos element in the created world, human beings remain responsible for moral evil, since they know the difference between good and evil and have freedom to choose between them. This explanation of theodicy seems to me to be more satisfactory than Augustine's *privatio boni*, Barth's *das Nichtige*, and Moltmann's "annihilating nothingness that persists in sin and death," [54] or any of the other explanations outlined in the previous section.

It seems to fit, in many respects, with the reasoning of Rabbi Kushner[55] in his best-selling book, *When Bad Things Happen to Good People*. He sees creation as God's ordering of initial chaos and recognizes a remaining element of chaos, symbolized by the sea monster Leviathan in Job 41. However, he lacks the evolutionary view of creation, so to the question, "Why does God not intervene?" he can only reply that God cannot do everything and is suffering with us. I find this an unsatisfactory view of God's action; God does intervene—not in instantly curing each person's ills, but in the ongoing battle with remaining chaos. To me it seems clear that the key elements in explaining theodicy are chaos theology and the evolutionary view of creation (continuing creation). Evil is not attributed to God or to the effects of the sin of a mythical proto-human Adam. However, borrowing the slogan of the Dutch Tax Service, "We cannot make it more pleasant, but we can make it easier for you," I can say, evil does remain just that, but chaos theology makes it more understandable.

4. Original sin and predestination

The doctrine of original sin was first proposed by Irenaeus (c. 190) in his struggle against gnostic dualism. Since he was one of the first to adopt the *creatio ex nihilo* idea to combat dualism, he had to find an origin outside of God for sin. This he found in Paul's words:

> As sin came into the world through one man [i.e., Adam], ...many died through the one man's sin.
>
> (Rom 5:12-21)

Irenaeus interpreted these words to mean that evil came into the world through the sin of Adam. Didymus of Alexandria (c. 350) taught that Adam's sin was transmitted by natural propagation, and Chrysostom (390) and Augustine (400) attributed this to sexual lust. The latter idea was rejected by Thomas Aquinas and the Roman Catholic Church, but retained by Luther and Calvin.

My critique of this doctrine is that:

• it provides a fatalistic and pessimistic view of life in portraying human sinfulness as a kind of inherited disease (German, *Erbsünde*);

• Paul made a wordplay with "one for many," and only wanted to illustrate the superiority of grace over the power of sin;

• the author of Gen*esis* 3 tried to explain the universal human inclination to sin by composing the powerful myth of the Fall, but it is not permissible to turn the myth around and claim that all subsequent human sin was derived, inherited, from Adam;

• evolution theory teaches that new species originate in hundreds of individuals, so there cannot have been a single first human pair;

• human beings developed gradually over a period of 6 million years from *Australopithecus* via *Homo habilis* and *Homo erectus* to *Homo sapiens*; and along with this biological evolution, there appears to have been a religious and moral evolution.[56]

So, I feel that we can discard this somber doctrine and ascribe the universal human inclination to sin to the operation of the remaining chaos element.

The doctrine of predestination was invented by Augustine in reaction to the Irish monk Pelagius (400), who taught that a person takes the initial and decisive step towards salvation by one's own efforts, apart from the assistance of divine grace. Basing himself on the words of Paul, "those whom he foreknew he also predestined" (8:28-30), Augustine claimed that this means that God decrees the election and non-election of individuals. Calvin made predestination a cornerstone of his theological system, rejecting the universal saving will of God and maintaining that Christ's atoning death was offered only for the elect. To this, Reformed theologian Emil Brunner exclaims, "How terrible and paralysing is all talk of predestination."[57] My critique is that this doctrine neglects human free will and the other words of Paul:

> Therefore,...work out your own salvation with fear and trembling; for it is God who is at work in you, enabling you both to will and to work for God's good pleasure. (Phil 2:12-13)

Out of love for God's creatures, God may take the initiative, but leaving human beings the freedom to accept or reject God's offer. Chaos theology with the theory of chaos events suggests that God leaves to the evolving creation and creatures a large degree of freedom, intervening only in order to keep creation going towards the goal God set for it.

5. A theology of illness

Remarkably, neither dogmatic theologians nor scientist-theologians have given much attention to this topic, which is of such importance in human life, both physically and spiritually.[59] Many people still attribute disease to sin or to divine punishment for sin, leading to misplaced guilt feelings in many seriously ill people. Even Dame Cicely Saunders, founder of the hospice movement, believes this.[59] It was the predominant view in the Hebrew scriptures; but Jesus vigorously rejects the idea that disease is God's punishment, either for one's personal sins or for those of one's parents (Jn. 9:3). He sees a person as a unity of body and mind, and illness as the result of evil producing an imbalance in the body-mind unity. So, in his healing acts, he pays close attention to the mind of the sick, often linking healing with the forgiving of sins (e.g., Mk. 2:2-11).

Modern understanding of disease. I take cancer as a model, because it is a prevalent and serious disease, and we know so much about its biological mechanism. A single random mutation of one gene in one normal body cell makes it turn its neighbor cell into a malignant cell. This cell loses control of division through the blocking of two defense systems against unlimited division (apoptosis and telomere shortening), resulting in excessive multiplication. When the tumor has reached a diameter of 1.6 mm, it begins to suffer oxygen deficiency. This activates a gene, which produces a protein that effects blood vessel formation. The tumor can then continue to grow. The next step is metastasis: the cancer cell activates a quiescent enzyme that is secreted and "drills" a hole in a blood vessel wall. Through this hole the cancer cell enters the blood stream. It is carried along until it is stopped in a capillary bed. There it forms a secondary tumor. This process can be repeated with other cancer cells, leading to the formation of many secondary tumors. When a primary or secondary tumor disrupts essential body functions, the patient dies.

Theological interpretation. The initial mutation is a chaos event. The resulting cancer process is the derailment of a very complex, orderly, coordinated functioning of many genes, enzymes, hormones, and messengers that exists in body cells under normal conditions. This order has been established by the Creator in the course of evolutionary creation and is established anew in each individual, owing to the genetic system present in its cells. A chaos event, the random mutation of one gene in one cell, causes this order to degenerate to chaos on the cellular level. The same can be said for all diseases in which a normal physiological mechanism is derailed.

To me it seems clear that the key elements in explaining theodicy are chaos theology and the evolutionary view of creation (continuing creation). Evil is not attributed to God or to the effects of the sin of a mythical proto-human Adam.

Thus, chaos theology leads to the insight that cancer and other diseases are caused by the remaining chaos element disturbing the order established by the Creator in the evolutionary creation process. This theological interpretation agrees with the message of Jesus that disease is a manifestation of evil, a disturbance of divine order, but not a punishment for sins of sick persons or of their parents. Guilt (but not divine punishment) can be spoken of only when the disease is due to human negligence, e.g., liver cirrhosis through alcohol abuse, or AIDS infection through unprotected, promiscuous sex.

Curing or healing. The standard medical treatment for cancer is to remove or destroy the tumor by surgery (if there is no metastasis), radiation, chemotherapy, or a combination of these. This can, in many cases, greatly increase life expectancy with an acceptable quality of life. However, the problem is that total removal or destruction of every cancer cell in a patient is very difficult to achieve, if not impossible; so a true cure is still rare. Moreover, curing falls short of the healing of the body-mind unity that was an essential aspect of Jesus' healing acts.

The mechanism for the interaction between mind and body is beginning to be understood scientifically.[60] From the brain cortex, the seat of the mind, nerves run to the hypothalamus, which secretes activating substances to the nearby pituitary gland, making it secrete hormones that affect various body systems, including the immune system. Thus, one's mental state can influence immune function positively or negatively. There is evidence that transformation of a normal body cell into a cancer cell through random mutation occurs fairly frequently, but that the immune system will normally recognize such a cell and destroy it before it can form a tumor. When the immune system is impaired through mental problems (e.g., stress, conflict, guilt feelings) or physical conditions (e.g., by immuno-suppressive medication after a transplantation),[61] the chance of developing cancer is considerably increased.

Conversely, statistical studies show the importance of religious commitment (measured as attendance and participation) for combating cancer and other diseases.[62] Institutes now exist that offer programs to stimulate the patient's self-healing capacity, to supplement (not replace) conventional medical treatment.[63] The patients are helped to liberate themselves from wrong ideas about guilt, sin, and punishment, and to express their feelings of anger and anxiety, allowing them to reintegrate body and mind. In some studies, an enhancement of the immune function in such patients has been observed. Although such institutes operate on a non-religious basis, their approach resembles Jesus' practice of healing with forgiveness offered.

The practice in the early Church of the laying on of hands with prayer for healing has been revived in recent years in Anglican churches. Even if this does not lead to a cure, it may provide healing in the sense of receiving peace of mind and the assurance that God will guide us through the final stage of earthly life toward eternal life, the ultimate life for which we are created and destined. In my opinion, the sacrament of healing deserves a place in the Sunday Eucharist after the distribution of the consecrated elements, in the midst of the congregation. A form which shows a proper balance between curing and healing is provided in the 1979 *Book of Common Prayer* of the Episcopal Church in the United States.[64]

D. Conclusions

A critical study of the origin of the doctrine of *creatio ex nihilo* and the problems inherent in it have led me to the development of a new creation theology: chaos theology. It is based on the Genesis creation stories. The main points are: creation from an unexplained initial chaos, a remaining chaos element which is the source of physical and moral evil, and a continuing creation towards fulfilment on the Last Day. This chaos theology can be reconciled with the scientific account of cosmic and biological evolution, with the latter providing the mechanisms.

Combining chaos theology with the physical theory of chaos events provides an understanding of God's action in the world. God acts transcendently mainly in the initial creation, and immanently in continuing creation by influencing chaos events so as to keep it going toward its intended fulfilment.

Jesus Christ, God's creative Word incarnate in the human Jesus of Nazareth, is the cosmic Christ, who reconciles the entire cosmos, not only humankind. Chaos theology can correct the traditional theories of reconciliation.

The problem of evil, which has remained unsolved in *creatio ex nihilo*, can be readily solved in chaos theology as the effect of the remaining chaos element. Human beings remain responsible for moral evil because of their knowledge of good and evil and the freedom of will given them. The doctrines of original sin and predestination can be abandoned. From chaos theology and our scientific knowledge of the biochemical mechanisms of cancer, a theology of illness can be derived.

Works cited:

Barrow, John D., and Frank J. Tipler. *The Anthropic Cosmological Principle and the Structure of the Physical World.* New York: Oxford University Press, 1986.

Barth, Karl. *Church Dogmatics*, v. III, 2. Ed. G. Bromiley and T. F. Torrance. Edinburgh: T. &T. Clark, Edinburgh, 1960.

The Bible. Authorized King James Version. Cambridge: The University Press.

The Bible. New Revised Standard Version, copyright 1989, Division of Christian Education of the National Council of Churches of Christ in the United States of America.

Bonting, Sjoerd L. Chaos Theology: A New Approach to the Science-Theology Dialogue. *Zygon* 34, no. 2 (June 1999): 323-32.

_____. *Mens, Chaos, Verzoening*. Kampen, The Netherlands: Kok, 1998.

_____. *Schepping en Evolutie: Poging tot Synthese*. 2nd ed. Kampen, The Netherlands: Kok, 1997.

The Book of Common Prayer. According to the use of The Episcopal Church. New York: Church Hymnal Corporation, 1979.

Brunner, Emil. *The Christian Doctrine of God. Dogmatics.* London: Lutterworth, 1960.

Davies, Paul. *God and the New Physics.* London: Dent, 1983.

Drewermann, Eugen. *Exegese en Dieptepsychologie*. Zoetermeer, The Netherlands: Meinema, 1993.

Fergusson, David A.S. *The Cosmos and the Creator: An introduction to the Theology of Creation*. London: SPCK, 1998.

Gibbons, Ann. "When It Comes to Evolution, Humans Are in the Slow Class." *Science* 267 (1995): 1907-1908.

Gribbin, John, and Martin Rees. *The Stuff of the Universe: Dark Matter, Mankind and the Coincidences of Cosmology*. London: Penguin Books, 1995.

Goldsmith, Donald. "Supernovae Offer First Glimpse of Universe's Fate." *Science* 276 (1997): 37-38.

Gott, J. Richard. "Creation of Open Universes from de Sitter Space." *Nature* 295 (1982): 306.

Hefner, Philip. "God and Chaos: The Demiurge Versus the *Ungrund*." *Zygon* 19, no. 4 (Dec. 1984): 469-85.

den Heyer, C. J. *Verzoening, bijbelse notities bij een omstreden thema*. Kampen, The Netherlands: Kok, 1997.

Hick, John. *Evil and the God of Love*. Glasgow: Collins, 1979.

Houtepen, Anton. *God, een Open Vraag*. Zoetermeer, The Netherlands: Meinema, 1997.

John Paul II, Pope. *Fides et Ratio*. Encyclical.

Kuitert, H. M. *I Have My Doubts: How to Become a Christian Without Being a Fundamentalist*. [*Het algemeen betwijfeld christelijk geloof*.] Trans. John Bowden. London: SCM, 1993.

Kushner, Harold S. *When Bad Things Happen to Good People*. London: Pan Books, 1982.

Lewis, C. E., C. O'Sullivan, and J. Barraclough. *Psychoimmunology of Cancer: Mind and Body in the Fight for Survival*. Oxford: OUP, 1994.

Long, Charles H. "Primitive Religion." *Academic American Encyclopedia* (electronic version). Danbury, Conn.: Grolier, Inc., 1996.

Matthews, Dale A., and David B. Larson. *The Faith Factor: Annotated Bibliography of Clinical Research on Spiritual Subjects*. Rockville, Md.: National Institute for Healthcare Research, 1993-95.

May, Gerhard. Creatio ex nihilo: *The Doctrine of "Creation out of Nothing" in Early Christian Thought*. Edinburgh: T. &T. Clark, 1994.

Moltmann, Jürgen. *God in Creation*. San Francisco: Harper, 1991.

Moreland, J. P. , ed. *The Creation Hypothesis: Scientific Evidence for an Intelligent Designer*. Downers Grove, Ill.: InterVarsity Press, 1994.

Moyers, Bill. *Healing and the Mind*. New York: Bantam Doubleday Dell, 1993.

Peacocke, Arthur. *The Quest for Christian Credibility*. London: SPM, 1996.

_____. *Theology for a Scientific Age*. London: SCM Press, 1993.

_____. "Chance and Law in Irreversible Thermodynamics, Theoretical Biology, and Theology." In *Chaos and Complexity, Scientific Perspectives on Divine Action*, ed. by Robert J. Russell, Nancey Murphy, Arthur R. Peacocke, 123-43. Berkeley: Center for Theology and Natural Sciences, 1995.

Polkinghorne, John. *Science and Christian Belief*. London: SPCK, 1994.

_____. *Science and Creation*. London: SPCK, 1988.

_____. "The Nature of Physical Reality." *Zygon* 26, no. 2 (1991): 221-236.

Rial, J. A. Book review of *Chaos: An Introduction to Dynamical Systems*, by Kathleen T. Alligood, Tim D. Sauer, and James A. Yorke (New York: Springer-Verlag, 1996). *American Scientist* 85, no. 5 (1997): 487-88.

Russell, Robert J. "Is Nature Creation?" In N. H. Gregersen et al., *The Concept of Nature in Science and Theology. Studies in Science & Theology*, vol. 3. Geneva: Labor et Fides, 1995.

_____. "Entropy and Evil." *Zygon* 19, no. 4 (Dec. 1984), 449-68.

Saunders, Cicely. *Care of the Dying*. London: Macmillan, 1962.

Schillebeeckx, E. "Experiencing Pleasure and Anger with God's Creation." *Tijdschrift voor Theologie* 33, no. 4 (1993): 325-47.

Schleiermacher, Friedrich. *The Christian Faith*. Edinburgh: T.&T. Clark, 1986.

Seife, Charles. "BOOMERANG Returns With Surprising News." *Science* 288 (28 April 2000): 595.

Stonier, Tom. *Information and the Internal Structure of the Universe*. London: Springer Verlag, 1990.

Tillich, Paul. *Systematic Theology*. Chicago: University of Chicago Press, 1951.

_____. *The Courage To Be*. London: Fontana, Douglas, 1962.

Thomas, Lewis. *The Youngest Science: Notes of a Medicine-Watcher*. New York: Viking Press, 1983.

Ward, Keith. *God, Faith and the New Millennium: Christian Belief in an Age of Science*. Oxford: OneWorld, 1998.

Westermann, Claus. *Genesis 1-11: A Commentary*. Tr. John J. Scullion, S.J. London: SPCK, 1994.

_____. *Creation*. Tr. John J. Scullion, S.J. London: SPCK, 1974.

Worthing, Mark W. *God, Creation, and Contemporary Physics*. Minneapolis: Fortress Press, 1996.

Endnotes:

1. An earlier account of chaos theology appeared as "Chaos Theology: A New Approach to the Science-Theology Dialogue," by Sjoerd L. Bonting.

2. May.

3. Theophilus.

4. Irenaeus.

5. Barth, *Church Dogmatics* III, 2, pp. 154ff.

6. Polkinghorne, *Science and Christian Belief*, p. 76.

7. Westermann, *Genesis 1-11*, pp. 110, 121.

8. Fergusson, p. 23.

9. Worthing, pp. 79-110.

10. Polkinghorne, *Science and Creation*, p. 59.

11. Peacocke, *The Quest for Christian Credibility*, p. 31.

12. Barth, pp. 154ff.

13. Brunner, pp. 9-21.

14. Tillich, *Systematic Theology*, vol. 1, p. 188.

15. Worthing, p. 75.

16. Ward, pp. 53-59.

17. Moltmann, *God in Creation*, pp. 86-93.

18. Fergusson, p. 27.

19. Bonting, *Schepping en Evolutie*, pp. 34-36.

20. Long.

21. Westermann, *Creation*, p. 41.

22. Drewermann, p. 27.

23. Peacocke, "Chance and Law."

24. Stonier, pp. 38-41, 70-72.

25. Gibbons, pp. 1907-08.

26. Peacocke, *Theology for a Scientific Age*, pp. 50-53.

27. Polkinghorne, "The Nature of Physical Reality," p. 221-36

28. See Rial.

29. Russell, "Is Nature Creation?" p.117.

30. Tillich, *The Courage To Be*, pp. 41-68.

31. Gribbin and Rees; see also Goldsmith, pp. 37-38.

32. Davies, p.179. For direct evidence for a flat universe from background radiation measurements, see "The Flip Side of the Universe," by George Musser, *Scientific American*, 279:3 (1998), p. 13.

33. Seife, p. 595.

34. Moreland, pp. 141-172, Table 4.4.

35. Barrow and Tipler.

36. Gott.

37. Bonting, op. cit., pp. 82-99.

38. Bonting, *Mens, Chaos, Verzoening*, pp. 36-42.

39. den Heyer, p. 136.

40. Houtepen, p. 97.

41. John Paul II, par. 76.

42. Hick.

43. Schleiermacher, p. 337.

44. Houtepen, pp. 97-103.

45. Ibid., pp. 104-125.

46. Ibid., pp. 91-93.

47. Schillebeeckx, pp. 325-47.

48. At Nymegen, 15 Jan. 2000.

49. Kuitert, p. 76 in the Dutch edition.

50. Worthing, pp. 146-156.

51. Russell, "Entropy and Evil," pp. 457ff.

53. Hefner, pp. 483.

54. Moltmann.

55. Kushner.

56. Bonting, *Schepping en Evolutie*, pp. 154-65.

57. Brunner, vol. 1, pp. 303-339.

58. Moltmann, pp. 270-75. He makes some useful critical comments on the modern view of health and disease, but these do not lead to a theology of this aspect of human life.

59. Saunders, p. 2: " ...disease and all our other ills were caused in the first instance by the sin of man. These things are permitted by God because He can use them to serve His own purposes and bring about an even greater good in the end."

60. Lewis, O'Sullivan, and Barraclough.

61. Thomas, pp. 204-205.

62. Matthews and Larson.

63. Moyers.

64. The Book of Common Prayer, p. 456: "I lay my hands upon you in the name of the Father, and of the Son, and of the Holy Spirit, beseeching our Lord Jesus Christ to sustain you with his presence, to drive away all sickness of body and spirit, and to give you that victory of life and peace which will enable you to serve him both now and evermore."

The Reverend Dr. Sjoerd L. Bonting was born in 1924 in Amsterdam. After earning his Ph.D. in biochemistry at the University of Amsterdam, he came to the U.S. in 1952 as a National Institutes of Health Postdoctoral Fellow. From 1952-1960, he worked at the University of Iowa, the University of of Minnesota, and the University of Illinois; and the years from 1960-1965 he spent at the National Institutes of Health (Bethesda, Md.). He returned to the Netherlands in 1965 as professor and chairman of the Department of Biochemistry at the University of Nijmegen. He returned to the U.S. once more in 1985, as a scientific consultant at NASA Ames Research Center (Mountain View, Cal.), for preparation of biological research on the International Space Station (1985-93).

After studying theology, he was ordained priest in the Episcopal Church in 1964 and is a member of the Society of Ordained Scientists, a dispersed preaching order of the Anglican Church. In the Netherlands, he served as Anglican chaplain for English-speaking persons, founding four congregations (Nijmegen, Eindhoven, Arnhem, Twente) between 1965 and 1985. In California, he was served two parishes. Since his return to the Netherlands in 1993, he has been active again as chaplain and in writing and speaking on science and theology. He is the author of three books in Dutch: Creation and Evolution *(1996);* Humanity, Chaos, Reconciliation *(1998); and* Between Belief and Unbelief, Christ and Secularization *(2000).*

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The Quest for the Causal Joint

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This study is an examination of three proposals for a "causal joint" model of God's action in the world. Adapting the thought of Austin Farrer and David Burrell, the author seeks to show how these hypotheses are theologically flawed. The flaws stem from an overemphasis on the doctrine of creatio continua. *Without an affirmation of both* creatio ex nihilo *and* creatio continua, *the latter is mistakenly removed from its theological context and adds unnecessary incoherence to the doctrine of creation.*

Seven-year-old Amy asked her Sunday School teacher, "How did God make the universe?"

Her teacher answered, "God said, 'Let it be' and there it was."

Not satisfied Amy retorted, "All right then, but how does God keep it all going?"

Her teacher responded, "Well, I guess God hasn't stopped saying 'Let it be' yet."

In this exchange, Amy distinguishes between God's creative action and God's subsequent sustaining activity. Unknowingly, Amy stumbled upon the traditional distinction between the doctrine of *creatio ex nihilo* (creation out of nothing) and the doctrine of *creatio continua* (continuing creation).

The dialogue between science and religion, though still acknowledging the importance of *creatio ex nihilo*, currently focuses almost exclusively on *creatio continua*. Much of the current discussion addresses the question of God's action in the world. Namely, how may God's activity in the world be understood without reducing God to a *deus ex machina* or a god-of-the-gaps?

Some key participants in this dialogue consider the search for the mode of divine action a quest for a "causal joint" between God and the world. These thinkers look for physical processes open to God's non-energetic influence and capable of accounting for large-scale changes in the course of the world. The scientists and theologians involved in this quest insist that nothing less than the rationality of theology is at stake. Polkinghorne states it this way:

> [U]nderstandings of divine action will have about them the common feature that they are not irrational accounts of the whimsical acts of a celestial conjurer, but they are deeper manifestations of God's utter faithfulness and consistency....[1]

Thus, to avoid the impression of irrationality, theology must explain how God acts in the universe within the divinely created natural laws. For Christian theologians and scientists involved, the causal joint appears to represent the best chance of harmonizing the discoveries of contemporary natural science with traditional Christian theology.

Yet, does a successful causal joint proposal truly solve the problem of harmony between natural science and Christian doctrine of God? It is my contention that the causal joint quest is influenced by an overemphasis on *creatio continua*, thus compromising the traditional Christian doctrine of God. In this study, I shall first examine the causal joint hypotheses offered by John Polkinghorne, Nancey Murphy, and Arthur Peacocke. Then, I shall look at Austin Farrer's rejection of the causal joint argument. Finally, I shall explore how an affirmation of *creatio ex nihilo* and *creatio continua* can prevent placing the Christian doctrine of God in jeopardy.

Divine action according to chaos theory

John Polkinghorne contends that chaos theory presents a viable solution to the causal joint quest. Chaos theory is a mathematical explanation of hypersensitive nonlinear systems passing through a strange attractor, with the effects amplified into macrophysical events. In other words, chaos theory is an effort to explain systems that are effected by the minute changes in their initial conditions and are thus magnified as different possibilities on the macrophysical level. Chaos theory mathematics may seem to create the impression that these systems are entirely deterministic if only the entire detail of their initial conditions is known; however, Polkinghorne asserts that chaos theory does not represent deterministic events but rather an ontological openness in nature.[2]

The basis for Polkinghorne's contention for the ontological openness of nature lies in the Heisenberg uncertainty principle.

> Heisenberg's uncertainty principle, which made the epistemological assertion of the simultaneous unknowability of both position and momentum, has been widely interpreted as a principle of indeterminacy, with the ontological implication that quantum entities do not possess at all times definite positions and momenta.[3]

Polkinghorne argues that the world has an indeterminate character. This background material informs his concept of chaos theory as it relates to divine causality.

As explained above, a chaotic system passes through the strange attractor's phase space (its range of future possible states) and thus manifests itself in a physical event. The different trajectories through the attractor all correspond to the same total energy level. So, the radically different forms present at the macrophysical level are understood to have arisen from the smallest disturbances that push a system through one path instead of another at the initial condition level. Polkinghorne explains:

> It is this sensitivity that produces the intrinsic unpredictabilities. In a critical realist re-interpretation of what is going on, these epistemological uncertainties become an ontological openness, permitting us to suppose that a new causal principle may play a role in bringing about future developments.[4]

This leads Polkinghorne to two critical conclusions. First of all, since there is no input of energy into the system that affects paths through the strange attractor, something else must be the distinguishing factor for their development. Polkinghorne describes this factor as an information input.[5] Secondly, even though the system is being nudged at the smallest level possible, its effects are seen at the largest physical level. Polkinghorne says that this forces the entire system to be viewed in a holistic manner, because "the systems' vulnerability to disturbance means that they can never be isolated from the impact of their total environment."[6]

If the behavior observed in nature is interpreted in an ontological manner, an open-

God does not intervene in the world, though, because no energy is added to it. Instead, they maintain that God transmits information to the world in a non-energetic manner that in turn manifests the divine will.

ness in which God may act within creation can be seen. This openness operates at the level where the strange attractor needs an information input to choose one path over another. According to Polkinghorne, this is where God supplies an input of information. Polkinghorne calls this divinely supplied input "active information." It can best be explained by a human analogy. The mental intention a person has to raise an arm is the active information that causes the person's arm physically to move.[7] For Polkinghorne, then, this interpretation allows God to act providentially in creation without creating an additional input of energy into the world.

> The physical world is subtle and supple in its constitution. It is open to causal influence by the exchange of energy between its constituent parts (as described by physics) and also to the operation of holistic pattern-forming agencies which can be thought of as 'active information' (presently not described in detail).[8]

The quantum mechanical alternative

For another causal joint hypothesis, I shall now turn to Nancey Murphy.[9] Like Polkinghorne, she interprets the Heisenberg uncertainty principle in a manner that allows for an indeterminate view of nature. Unlike Polkinghorne, however, she explains God's divine activity in the world through the use of quantum mechanics. She argues that quantum events may be amplified by quantum mechanics in such a way that they may be seen at the macrophysical level.

According to the Heisenberg uncertainty principle, events at the quantum level cannot be predicted. Probabilities of quantum events can be predicted, but not the specific times of their occurrence. Since the time when a quantum event will occur cannot be predicted, Murphy asks whether there are factors that influence when an event will actualize:

> Is the when: (1) completely random and undetermined; is it (2) internally determined by the entity itself; is it (3) externally determined by the entity's relations to something else in the physical system; or, finally (4) is it determined by God?[10]

To help distinguish these options more clearly, Murphy presents the analogy of Buridan's ass. Buridan, the medieval philosopher, hypothesized that if a starving donkey stood equidistant between two equal piles of hay, it would starve to death, because it could not decide which pile to eat. No external factors can help the donkey make its decision because the piles are equal, and no internal factors can tilt the decision one way or the other. What factors, then, motivate a quantum event to "choose" its actualization?

No scientific considerations point to internal or external factors that nudge quantum entities to choose one actualization over another. Thus, Murphy eliminates options 2 and 3, concluding that only 1 and 4 are truly viable options. Buridan believed the donkey would starve to death if not provided a sufficient reason to pick one pile over the other. Murphy asserts that science holds the same "sufficient reason" intuition and, hence, has problems accepting randomness as the determining factor of quantum events.[11] Therefore, Murphy contends that God is the determining factor between the quantum level "piles of hay." "To put it crudely, God is the hidden variable."[12]

Murphy argues:

> God's governance at the quantum level consists in activating or actualizing one or another of the quantum entity's innate powers at particular instants, and that these events are not possible without God's action.[13]

Through a scientific bottom-up rendering of nature, Murphy concludes that since God governs at the quantum level, God must also be involved in all events at the macro level. In other words, these quantum level events accumulate in such a way as to "perform" the divine intention.[14]

Peacocke's holistic approach to divine action

Although Arthur Peacocke views the universe in the same open manner as those in the above discussion, he does not explicitly settle on a causal joint. He makes this argument:

> Defining the problem as that of the 'causal joint' between God and the world is inappropriate, however, for it does not do justice to the many levels in which causality operates in a world of complex systems multiply interlocking at many levels and in many modes.[15]

Therefore, Peacocke describes the interaction between God and the world as a "whole-part influence."[16] By this Peacocke means that

> ...the state of the system-as-a-whole could itself properly be regarded as a causal factor influencing events in the "lower" subsystems, constraining them to follow one course rather than another.[17]

In other words, God interacts with the world in such a way that the world system as a whole is in God, and, thus, also its constituent parts. Peacocke's model denies pantheism and embraces panentheism. Although the world lives in God, it is still "ontologically distinct from God."[18] Because God interacts with the world at "this supervenient level of totality," God acts in the world in "whole-part" or "top-down" manner, without disrupting physical laws found at any level of the universe.[19]

Since seeking for a causal joint makes less sense in a holistic framework, Peacocke develops a whole-part analogy of divine agency modeled on human agency. For Peacocke, then, the way the human brain works in influencing the whole body at the level of the individual neurons to produce bodily actions is comparable to the way God influences the world system.

> According to this suggestion the state of totality of the world-as-a-whole (all-that-is) would be known maximally only to the omniscience of God and would be the field of the exercise of the divine omniscience at God's omnicompetent level of comprehensiveness and comprehension.[20]

Hence, just as we consider ourselves personal agents who exhibit a unifying type of influence over our bodily actions, so too should we think of God as "a unifying, unitive source and centered influence on events on the world."[21]

Although he says that a causal joint is not visible from humanity's viewpoint, Peacocke asserts that there must be a divine transfer of information to the world in an analogous manner to the brain directing the body. Information transfer can be considered non-energetic, and therefore avoids the problem of an interventionist God. In fact, Peacocke argues that to affirm this non-energetic transfer is "to accept the ultimate, ontological gap between the nature of God's own being and that of the created world, all-that-is apart from God."[22] So, while using language that suggests he is not searching for a causal joint, Peacocke has still described the means by which he understands God must interact with creation and, thus, has joined the quest for the causal joint.

What does all this mean?

What, then, do these three causal joint hypotheses describe? They offer an account of an open universe. In other words, these thinkers have completely rejected the notion of a universe that is ruled by a deistic God or an interventionist God. The idea of an open universe, they assert, helps with an understanding that the world, in a sense, "makes itself."[23] This understanding allows an accommodation to the current evolutionary model presented by modern natural science. These thinkers argue that the universe must in some manner be open, if God is to interact immanently with creation. God does not intervene in the world, though, because no energy is added to it. Instead, they maintain that God transmits information to the world in a non-energetic manner that in turn manifests the divine will.

To a scientist , the notion that science might allow a recognition of the means by which divine action directs the world is intoxicating.

The divine will, however, at no time compromises the freedom God has given creation. Polkinghorne writes:

> God interacts with the world but is not in total control of all its process. The act of creation involves divine acceptance of the risk of the existence of the other, and there is a consequent kenosis of God's omnipotence.[24]

Polkinghorne is swift to observe that creation does not impose this kenosis upon God, but rather that God chooses self-limitation. Also, because the universe makes itself, Polkinghorne says that there is a kenosis of divine omniscience. Peacocke explains what this means with the following example. He says that if there are a million radium atoms set to disintegrate in the next 10^3 seconds, God does not know exactly which or how many atoms will remain intact after that. God, like us, knows only the probability of how many atoms will remain after the given time.[25]

The self-limitation concept has led Peacocke to argue that God is "an Improviser of unsurpassed ingenuity."[26] God allows the universe to unfold freely, yet non-energetically directs its actions. At the same time, God, as an improviser, must be willing to change or, in some sense, is subject to change since the Creator respects the freedom bestowed upon creation. Therefore, God must also limit the divine freedom so that creation may enjoy its own freedom.

A prior rejection of causal joint hypotheses

To a scientist (I, myself, spent my undergraduate years in a biology laboratory), the idea of unraveling the causal joint mystery is terribly exciting. The notion that science might allow a recognition of the means by which divine action directs the world is intoxicating. Scientists contend that the quest for the causal joint seeks only to sharpen human awareness and appreciation of how God works within the creation. As stated above, those involved in the quest feel a strong need to show that God rationally works within creation according to divinely established natural laws. Yet, is it necessary for scientists to demonstrate the rationality of God's interaction within creation? To discern this, I shall examine Austin Farrer's objection of the use of the physical sciences to model divine action. Then I shall examine the concept of God that Farrer says follows a divine causation model.

To determine whether or not physical sciences are up to the task of modeling divine action, the first question to ask is, What is the goal of the physical sciences? Since Francis Bacon, the physical sciences concentrate on performing experiments with the intent of objectively describing observations. The descriptions are written in the language of mathematics. Moreover, because of the physical sciences' use of mathematics as their descriptive language, observable events must be quantifiable and repeatable. In other words, the physical sciences describe the data of repeatable events in such a way that they can be summarized by mathematical equations. After these equations are accepted as accurate, scientists construct models that help predict future natural events. These models are accepted as true explanations for how nature works, unless and until another set of events and related equations prove them false.[27]

So Austin Farrer asks, Can the physical sciences model divine action? To do so would seem to argue that divine action is both quantifiable and repeatable. Farrer says that this is absolutely untrue. In a detailed explication he maintains:

> The inapplicability of the model offered by physical method seems scarcely to need demonstration. By systematic physical interference we obtain knowledge of the habitual action of natural agents, a habitual action grounded in their determinate constitutions; it is only in so far as their constitutions are determinate and their action consequently uniform, that we can discover anything about them by the physical method. Unless God is a finite determinate force, bound by natural law, he cannot be known in this sort of way. Experience of the physical type can never tells us anything about him....[28]

Therefore, if a physical model is constructed that describes divine action, Farrer says that God is made out to be one force among the many possible natural physical forces. Thus, he argues that this is not the notion of God maintained in the Christian tradition, for this is a god whose causality is explained, whose mysteries have been solved, and whose sovereignty has been breached. Hence, Farrer declares that the "physical model reveals its inadequacy by blotting out the very subject we come to study, the divine." [29]

Secondly, Farrer argues that the physical sciences severely limit our model of God. According to Farrer, the god described by science is a finite force defined by created laws of nature. Also, if God works through a causal joint, divine power will be limited in order to leave space for creation to act freely, for God has to restrict the divine power and divine knowledge so that creation's freedom might remain unfettered. In other words, creation limits God. We are supposed to take comfort, however, in the thought that the God's limitation is self-imposed.[30] How is it comforting, though, if God has to reduce the divine being in order to interact with a free creation? Does this not imply that human freedom and divine freedom are in competition?

Farrer has rejected the quest for the causal joint because he understands it to change radically the Christian doctrine of God. By blotting out the divine, the physical sciences have replaced God with a force that has limited power over creation. Consequently, human freedom and divine freedom are left to compete. Yet, this is not what either Christian theologians or scientists involved in the causal joint quest are seeking to describe. Therefore, it must be shown how a proper understanding of both *creatio ex nihilo* and *creatio continua* will not compromise the traditional doctrine of God.

What do we mean by creation?

When seeking to discern the fundamental relationship between the Creator and creation, one turns to the Christian distinction between *creatio ex nihilo* and *creatio continua*. *Creatio ex nihilo* articulates the Christian idea that God created the world out of nothing—not a pool of some kind of nothing, but nothing at all. *Creatio ex nihilo* thus implies creation's dependence upon God for every moment of its existence and, simultaneously, the affirmation that "God is no more God for creating."[31] This qualification is essential to *creatio ex nihilo*, because the world's dependence on God for existence alone could be misinterpreted as creation being an eternally necessary emanation out of God. So, creation must be regarded as a divine gift of grace rather than something that occurred necessarily. Yet concurrently, creation does not take away from or add to God's perfection, "though it adds to what there is—as in transfinite arithmetic, where infinity plus a definite amount equals infinity." [32] Although creation is a free choice by God, it is not an arbitrary one. Christian theology maintains that God's decision to create the universe is consonant with the divine nature, but not necessitated by it.

> Hence creation can be utterly gratuitous without its needing to be conceived as a "free choice", as though "God could have done otherwise." [33]

Creatio continua "encompasses not only the idea that the act of creation is a continuing process, but also the continuing sustenance and involvement of the Creator in regard to the physical world." [34] This, however, cannot be separated from *creatio ex nihilo*. Ted Peters contends that a healthy Christian theology needs both *creatio ex nihilo* and *creatio continua*.[35] Wolfhart Pannenberg explains:

> The *creatio continuata* formula presupposes the strict conception of creation as *creatio ex nihilo* inasmuch as it characterizes God's preserving activity as the continuation of the creation out of nothing. For this reason alone the idea of a continuing creation cannot be set in opposition to the *creatio ex nihilo* formula.[36]

Peters says that the contemporary science-and-religion discussion has led many theologians to concentrate more heavily on *creatio continua* than *creatio ex nihilo*, leading some to forsake the latter.[37] Theologians use the modern scientific interpretation of the universe as dynamic and continually evolving to reenergize and concentrate solely on the doctrine of *creatio continua*. Peacocke says:

> The scientific perspective on the world and life as evolving has resuscitated the theme of *creatio continua* and consideration of the interplay of chance and law (necessity) led us to stress the open-ended character of this process of the emergence of new forms.[38]

Does the divine action of conserving creation, though, fundamentally differ from the action of creating out of nothing? David Burrell, relying on Thomas Aquinas, helps in understanding what it means to say that "God creates."

> Aquinas offers us a handy formula: there is no difference between God's conserving activity and God's creating, other than the proviso that creating presumes nothing at all to be already present (ST 1.104.1).[39]

In other words, divine activity is defined by divine creating. Burrell says further that if this formula is added to Thomas' theorem,

> "...the proper effect of the universal cause of all things is things' existing" (ST 1.45.5), then God's activity in the world is ever an instance of or a consequence of bestowing existing (*esse*).[40]

By creating, therefore, God gives existence to something; and by conserving it, God continues to give it existence.

In causal joint hypotheses, though, God's conserving action is not characterized by creating, but by an input of information. This information does not bestow continued existence on creation, but seeks, rather, to offer it direction. This divine input of information may be depicted as non-energetic intervention. Burrell, however, says that God should not be thought of as intervening, "since creating cannot be represented as another vector added to the configuration of forces in the universe."[41] Therefore, without asserting that God's conserving action is the same as the divine creating action, causal joint supporters imply that existence is the "floor" upon which the Creator works.[42]

To do this, though, would be to deny the fundamental proposition of *creatio ex nihilo*. *Creatio ex nihilo* says that the world is contingent upon God for its being—it does not exist at all on its own. Causal joint proponents do not deny this. Nevertheless, when it is argued that God's creative and conserving action are not the same, the doctrine of *creatio ex nihilo* is jeopardized by implicitly positing that God interacts with a world that is not completely under divine control. In other words, when *creatio ex nihilo* is compromised, God is made to work on the floor of existence and consequently compelled to input information into a world that is independent of the divine being for its existence. Therefore, God is forced to improvise with the materials provided by creation.

The consequence of misconstruing *creatio ex nihilo* is to cause God's freedom to compete with creation's freedom. Polkinghorne argues:

> This gift of creaturely freedom is costly, for it carries with it the precariousness inherent in the self-restriction of divine control.[43]

Is self-limitation, then, the only option for God? Instead of focusing their efforts on depicting divine freedom, theologians should concentrate energy on understanding creation's freedom. Creation's freedom is a contingent freedom and, therefore, a limited freedom. Yet, as T. F. Torrance says, "It is no less free because it is limited. Unlimited freedom of a contingent universe would be a contradiction in terms."[44] Creation's freedom is

When* creatio ex nihilo *is compromised, God is made to work on the floor of existence and consequently compelled to input information into a world that is independent of the divine being for its existence.

contingent on God and consequently is limited only by the divine freedom. If creation's freedom exists only because of divine freedom, how are they in competition? To imply that God limits the divine freedom in order to make creation truly free is to deny that creation's freedom is contingent upon the Creator.

Where has this led?

The goal of the causal joint argument is to clarify an understanding of God. Causal joint proponents argue that scientific findings can complement traditional Christian theology about God. Further inquiry shows that this is not accurate. Firstly, a review of Austin Farrer's objection to the causal joint debate showed that the physical sciences cannot model divine action without reducing God to a quantifiable, repeatable, and finite force. Secondly, I have shown that the causal joint quest relies much too heavily on a truncated notion of *creatio continua*. This then leads to the exclusion of fundamental parts of *creatio ex nihilo*. As a result, creation no longer depends completely on God for existence, but waits, rather, for occasional divine inputs of information. The uncertainty of creation's contingence upon God, then, has caused subsequent confusion about the relationship between creation's freedom and divine freedom. This confusion has led causal joint supporters to argue for a self-limited God. Ultimately, then, causal joint insights have been shown not to clarify the doctrine of God, but rather to render it incoherent.

Where then has this led? Is the causal joint question truly insoluble? While this may be, as Polkinghorne states, "too intellectually despairing an attitude to take,"[45] it may be the only acceptable attitude if one is truly concerned with maintaining the core of the traditional Christian doctrine of God. For both *creatio ex nihilo* and *creatio continua* must be affirmed; any understanding of God as the Creator is dependent upon it. God the Creator creates by bestowing existence and conserves creation by continuing that original bestowal of existence—God does not merely input information into an already existing system. Undoubtedly, this is a very difficult pill to swallow for some involved in the science-and-religion dialogue. Yet, they should take comfort in the idea that the God who remains mysterious is the God who should be praised. Therefore, no one should disparage Amy's teacher for a seemingly naive attitude; instead, one should be joyfully consoled by those wise words, "I guess God hasn't stopped saying 'Let it be' yet."

Works cited:

Bersky, Ann. "Room for God?" *The Journal of Faith and Science Exchange* 3 (1999): 119-29.

Burrell, David. *Freedom and Creation in Three Traditions*. Notre Dame: University of Notre Dame Press, 1993.

_____. "Divine Practical Knowing: How an Eternal God Acts in Time." In *Divine Action: Studies Inspired by the Philosophical Theology of Austin Farrer*, ed. by Brian Hebblethwaite and Edward Henderson, 93-102. Edinburgh: T & T Clark, 1990.

Clayton, Philip. *God and Contemporary Science*. Edinburgh: Edinburgh University Press, 1997.

Doran, Chris. "Molding the Physical World Upon Francis Bacon's Anvil." *The Journal of Faith and Science Exchange* 3 (1999): 163-74.

Farrer, Austin. *Faith and Speculation*. New York: New York University Press, 1967.

Highfield, Ronald. "The Function of Divine Self-limitation in the Theology of Jürgen Moltmann." Unpublished manuscript, 2000.

Murphy, Nancey. "Divine Action in the Natural Order: Buridan's Ass and Schrödinger's Cat." In *Chaos and Complexity: Scientific Perspectives on Divine Action*, ed. by Robert John Russell, Nancey Murphy, and Arthur Peacocke, 325-57. Berkeley: Center for Theology and Natural Sciences, 1995.

Peacocke, Arthur. *Theology for a Scientific Age: Being and Becoming—Natural, Di-*

vine, and Human. Enlarged ed. Minneapolis: Fortress Press, 1993.

_____. *God and the New Biology*. London: Dent, 1986.

_____. *God and the World of Science*. Oxford: Oxford University Press, 1979.

_____. "God's Interaction with the World: The Implications of Deterministic 'Chaos' and of Interconnected and Interdependent Complexity." In *Chaos and Complexity: Scientific Perspectives on Divine Action*, ed. by Robert John Russell, Nancey Murphy, and Arthur Peacocke, 263-87. Berkeley: Center for Theology and Natural Sciences, 1995.

Peters, Ted. "On Creating the Cosmos." In *Physics, Philosophy, and Theology: A Common Quest for Understanding*, ed. by Robert John Russell, William R. Stoeger, S.J., and George V. Coyne, S.J., 273-96. Vatican City State: Vatican Observatory, 1988.

Polkinghorne, John. *Belief in God an Age of Science*. New Haven: Yale University Press, 1998.

_____. *The Faith of a Physicist*. Minneapolis: Fortress Press, 1996.

_____. "Chaos Theory and Divine Action." In *Religion and Science: History, Method, Dialogue*, ed. by W. Mark Richardson and Wesley J. Wildman, 243-52. New York: Routledge, 1996.

_____. "The Laws of Nature and the Laws of Physics." *In Quantum Cosmology and The Laws of Nature: Scientific Perspectives on Divine Action*, 2nd. ed., ed. by Robert John Russell, Nancey Murphy, and C. J. Isham, 429-40. Berkeley: Center for Theology and Natural Sciences, 1996.

Southgate, Christopher, coordinating ed. *God, Humanity and the Cross*. Harrisburg, Pa.: Trinity Press International, 1999.

Torrance, T. F. *The Trinitarian Faith*. Edinburgh: T & T Clark, 1988.

Worthing, Mark William. *God, Creation, and Contemporary Physics*. Minneapolis: Fortress Press, 1996.

Endnotes:

1. Polkinghorne, "Chaos Theory and Divine Action," p. 251.

2. Polkinghorne, "The Laws of Nature and the Laws of Physics," p. 433.

3. Polkinghorne, *Belief in God an Age of Science*, p. 53.

4. Ibid., p. 62.

5. Ibid.

6. Ibid.

7. Polkinghorne, "Chaos Theory and Divine Action," p. 248.

8. Ibid., p. 247.

9. Southgate, p. 254. According to Southgate, the same position is represented by Nancey Murphy, Thomas Tracy, and George Ellis.

10. Murphy, p. 341.

11. Ann Bersky aptly illustrates the ineffectiveness of the Buridan's ass analogy, because "[h]aving assumed no 'sufficient reason,' external or internal, for any subatomic entity to act, Murphy presents the false dichotomy of 'complete randomness or divine determination.' Any notion of choice that might have been extracted from the analogy of the Buridian [*sic*] ass is nixed. Murphy's subatomic particles are allowed no choice, no chance to respond to each other or to the environment, like a leaf in the wind. Complete randomness is rejected simply because it is counter-intuitive." See Bersky, p. 123.

12. Murphy, p. 342.

13. Ibid.

14. Murphy, however, does not make it clear whether God determines when every quantum event will actualize, or determines only when important events will actualize. This would seem to make a distinction between everyday "ordinary" events and important "providential" events.

15. Peacocke, *Theology for a Scientific Age*, p. 157.

16. Southgate, p. 257. Peacocke originally termed this phenomena "top-down causation" (*Theology for a Scientific Age*, p. 157) and

then renamed it "whole-part constraint" ("God's Interaction with the World," p. 272).

17. Peacocke, *Theology for a Scientific Age*, p. 157.

18. Peacocke, "God's Interaction with the World," p. 282.

19. Peacocke, *Theology for a Scientific Age*, 159.

20. Peacocke, "God's Interaction with the World, p. 284.

21. Ibid., p. 285. For a further explanation of the panentheistic analogy, see Clayton, pp. 232-65.

22. Peacocke, "God's Interaction with the World, p. 287.

23. Polkinghorne, *The Faith of a Physicist*, p. 76.

24. Ibid., p. 81.

25. Peacocke, *Theology for a Scientific Age*, p. 155. Murphy disagrees with Peacocke's model of divine self-limited omniscience, arguing that her proposal "evades this difficulty since by hypothesis these [quantum] events are not random; they are manifestations of divine will" (Murphy, p. 355).

26. Peacocke, *God and the New Biology*, p. 98.

27. Doran, p. 169.

28. Farrer, p. 38.

29. Ibid., p. 48.

30. Ronald Highfield argues, in his unpublished manuscript, that the idea of self-limitation cannot be applied to God because it presupposes "a prior essential limitation," for the notion of a limitation immediately evokes the concept of possibilities beyond that limit. And if this is true, the realm of possibilities which exists beyond the limitation is actually the controlling factor of that which is self-limited. In other words, God cannot be self-limited, unless theology is willing to posit a realm of possibilities greater than the knowledge and power of God.

31. Burrell, "Divine Practical Knowing," p. 95.

32. Ibid.

33. Ibid.

34. Worthing, p. 113.

35. Peters, p. 274.

36. Pannenberg, quoted in Worthing, p. 113.

37. Peters, p. 290.

38. Peacocke, *God and the World of Science*, p. 75.

39. Burrell, *Freedom and Creativity*, p. 68. Burrell uses ST as an abbreviation for Thomas Aquinas' *Summa Theologiae*.

40. Ibid.

41. Ibid., p. 70.

42. Ibid., p. 68.

43. Polkinghorne, "Chaos Theory and Divine Action," p. 249.

44. Torrance, p. 107.

45. Polkinghorne, "The Laws of Nature and the Laws of Physics," p. 437.

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Religion, Mathematics and Nothing

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The concept of "nothing" is important in both mathematics and theology. Its most obvious use in mathematics is in the number zero which arrived in Western Europe in the 12th Century. In theology it features significantly in the dogma of creatio ex nihilo, *which was taught by a Council in 1215* C.E. *Noting the relative proximity of these two events leads to the research task described in this essay: an exploration of the influence of mathematics on theology, with respect to the notion of nothing.*

Twelfth-century Europe was profoundly affected by the Crusades. One manifestation of this fact was a rise in trade, necessitated by the support of large, distant armies. Another was a direct contact with Muslim cultures. Merchants and scholars noticed that Muslims did their calculations more swiftly, and recorded their results in a more condensed fashion. Whereas Christians still used the traditional Roman numerals, Muslims figured with Indian numerals, and used the positional notation which enabled a set of ten symbols to represent any number. We are now very familiar with that symbol set: 1, 2, 3, 4, 5, 6, 7, 8, 9 and 0. The last symbol "0" is critically important. It could act as a "place-holder" allowing, for example, 402 to be distinguished from 42. Standing alone, the symbol is the numeral for the number zero.

A now lost Arabic text by Abu Ja'far Muhammed ibn Musa Al-Khwarizmi (c. 780-c. 850 C.E.) was translated as *Algoritmi de numero Indorum*, (*Al-Khwarizmi on Indian Numbering*). There were at least seven treatises[1] written in Latin about this text during the twelfth century. Since the text provided "procedures for doing calculations," these came to be known as "algorithms" from the first word of the title—the transcription of Al-Khwarizmi's name. One of the exponents of this new number system, and of zero in particular, was Abraham ben Meir ibn Ezra (1092–1167). A Jew born in Muslim Spain, he was said to have traveled in North Africa and Egypt. After 1140 C.E., he wandered throughout Europe, eventually settling in Rome, where he lived until a few years before his death. In Italy, Leonardo Pisano Fibonacci published, in 1202 C.E., his famous work on calculation, *Liber abbaci*. As the thirteenth century opened, mathematicians in Europe were discussing numbers in general, and especially zero. From this time on, zero would be established as the mathematical symbol for the quantity "nothing." Rabbi ben Ezra and Fibonacci had ensured that learned Italians, and particularly Romans, were fully informed about these mathematical developments.

In 1215 C.E. the Catholic Bishops, assembled in Rome for the Fourth Lateran Council, solemnly taught:

> God by his almighty power at the beginning of time created from nothing both spiritual and corporeal creatures.[2]

This teaching came to be known as *creatio ex nihilo*.

European mathematicians started teaching about zero, and the Roman Catholic Church made its first dogmatic statement about *creatio ex nihilo* during the same period of history. Are these two facts connected? Did the numeral "zero" and the number it represented help European thinkers focus on the elusive concept of nothing? Did mathematics influence theology?

Hypothesis: Judeo-Christian theology gained the idea of a complete absence (true zero) from mathematics.

For this hypothesis to be true, there ought to be no evidence of the use of the concept before the introduction of zero.

The first recorded use of a zero symbol was by the Babylonians in the third century B.C.E.; but it served only as a place-holder in a large number, not as a symbol for the number expressing nothing. After that, there was a long period with almost no recorded uses of the symbol. In the fourth century C.E., the Mayans on the American continent employed a zero symbol both as a place-holder and as an expression of the number for nothing. However, this had no effect on the Christian world. Finally, in India, around the middle of the fifth century C.E., zero was again invented. Its use spread to Cambodia around the end of the seventh century, from there to China, and then to Islamic countries at the end of the eighth century.

The hypothesis claims that, with the arrival of zero, Christian theologians were able to focus on the idea of a complete absence or absolute nothingness. This latter, however, is a commonplace in modern thought. Physicists posit a hard vacuum in outer space, and an absolute zero as the lowest possible temperature. It is now taken for granted that there is a whole number before 1. This was not always the case. Mathematics started out as a very practical science and, in the words of Alfred North Whitehead, "No one goes out to buy zero fish." The suggestion implicit in the hypothesis is that, prior to the introduction of the zero symbol, the idea of a complete absence was in a kind of "cultural blind spot." In other words, something was "there" but not directly adverted to. Being constantly aware of concrete reality around them and being accustomed to counting from "one," people did not think about "nothing" in an explicit manner.

To investigate the hypothesis, one should consider the Judeo-Christian tradition prior to the Lateran Council of 1215. Is there evidence of familiarity with "nothing" in connection with creation? Did the writers of Old Testament Hebrew have a clear notion of complete absence?

European mathematicians started teaching about zero, and the Roman Catholic Church made its first dogmatic statement about* creatio ex nihilo *during the same period of history. Are these two facts connected?

Arguably, the first words of Genesis (fig. 1) can be read as a creation starting from chaos. The three creative actions that follow it, and for which the verb ברא (*bārā*, create) is again used, are separations: light from darkness, waters above from waters below, and dry land from seas. There is a dichotomy in the phrase of "the heavens and the earth" which appears to signify "all things." The *terminus ad quem* of creation is clear. The *terminus a quo* is not. It does not speak of a complete absence before creation began. The evocative phrase תהו ובהו (*Tōhû wābōhû*, without form and void) describes the earth. "Void" is one of the words that is significant in the history of zero. The Indian inventors of zero called it *sunya*, meaning "void."

In the second creation account, found in Genesis 2:4b-9, the starting point seems to be a barren, uncultivated world. So as to create, God וייצר (formed), ויטע (planted), ויצמח (made to grow), and ויפח (breathed).

The human race comes into existence, not as a creation *ex nihilo*, but as a work shaped עפר מן־ האדמה (of dust from the ground).

If the idea of a "complete absence" was difficult to conceive before the influence of zero, then one would expect that the Hebrews had difficulties with it. There is some evidence of this with relation to two aspects of thought in the Hebrew Bible: the non-existence of gods other than Yahweh, and the afterlife.

Frequently in the Hebrew scriptures, there are convoluted ways of stating that other gods *do not exist*. For example, "Yahweh is the true God, and there is no other" (Deut 4:35b) is a clear affirmation of monotheism. But a few verses earlier the author writes: "There you will serve gods made by human hand, of wood and of stone, that cannot see or hear, eat or smell" (Deut 4:28). The other gods are identified with their statues. Hebrew religious thought, as well as that of the neighboring cultures, was generally capable of distinguishing between the idol and the god it represented. Yet, in order to deny the existence of the god, the author of Deuteronomy denies its ability to perform basic functions. So as to assert that "Your god is nothing," the claim is made that "Your god's statue cannot do anything."

The understanding of the afterlife develops during the biblical period. In classic Judaism, it seems that, after human beings die, they were believed to become shadows and go down to a realm where they can do nothing: "There is neither achievement, nor planning, nor science, nor wisdom in Sheol where you are going" (Eccl 9:10b). In Sheol it is not possible even to praise God.[3] This early conception of Sheol does not distinguish between the fate of the virtuous and that of the sinners. All go to the same shadowy place. This could be an elaborate way of suggesting that, after death, *one no longer exists*. Again, rather than make an ontological statement, the authors of the Hebrew Bible expressed non-existence in functional terms. In order to affirm that human beings cease to exist, they claimed that they are no longer able to do anything. They expressed non-existence in terms of doing rather than being—just as they did with the gods whose reality they wished to deny.

What links the ambivalence in addressing non-existence with the invention of zero is the way counting was done. What compounded the difficulty for the Hebrews, and the Greeks after them, was that they used their alphabet as numerals.

The first alphabet is thought to have been developed along the eastern shore of the Mediterranean between 1700 and 1500 B.C.E. This North Semitic alphabet evolved from a combination of cuneiform and hieroglyphic symbols; some of these might have been taken from kindred systems, such as those of the Cretan and Hittite. The North Semitic alphabet consisted exclusively of consonants. The vowel sounds of a word had to be supplied by the speaker or reader. The alphabet revolutionized written communication and, as a consequence, the recording and distribution of knowledge. If Marshall McLuhan is correct, this transformed the entire mindset of Western civilization.[5]

An obvious, though mistaken development to the invention of the alphabet was its employment to signify numbers. The symbols that represented phonemes were given a numeric significance (cf. fig. 2). In post-exilic Hebrew *'alef* was one, *yod* ten, and *qof* one hundred. The twenty-four Hebrew characters made the representation of whole numbers from 1 to 499 simple. Beyond this, an additive principle applied: 500 was represented by two symbols, that for 400 and that for 100. Fractions were represented as the ratio of two whole numbers. Since the system is not positional, the order of the characters is irrelevant to their numeric value: both תק and קת represent 500. There are many ways of writing the same number, and every word and phrase has a numeric value. For example, יהוה (YHWH), the sacred name of God, can be read merely numerically as 10 + 5 + 6 + 5 = 26.

This led to perceived connections between words of the same numeric value, to an interest in codes, to the number of the beast, and, ultimately, to the arithmetic mysticism of the Cabala. What it did not lead to was zero. The system had no place for zero and no need of it. It did not require a placeholder zero because it was not positional, קד (104) could not be confused with יד (14).

Calculations were very difficult, and large numbers are cumbersome. When the Hebrews started a count in this system, they began with *`alef*. For those who had learned their alphabet by rote, the question, "What number comes before `alef?" was obviously nonsense.

Thus, the Biblical authors writing in Hebrew had no zero. To be precise, they had no numeral zero, and they did not recognize zero as a number. A number is a quantity, an abstraction of a collection of things. As Bertrand Russell noted:

> It must have required many ages to discover that a brace of pheasants and a couple of days were in both instances the number two.[4]

The step to discovering that the empty collection, that is, one consisting of "no things," could be abstracted to produce a number was a further, difficult step.

At this point in the survey of the religious and mathematical tradition, the hypothesis is partially supported. The notion of a complete absence—that is, of an ontological non-existence from whence creation could come—and that of zero as a number, seem to have been obscured in a cultural blind-spot. It is plausible that the ancient Hebrew mindset did not advert to either.

The next culture to impact on the Judeo-Christian theological tradition was that of the Greeks. Did they fare any better? Their number system was also inextricably linked with their alphabet (cf. fig. 3). However, the use of obsolete characters was a step in the direction of two distinct symbol sets. Again, there was neither need of a positional zero, nor any thought of a number for nothing.

According to the hypothesis, this absence of the concept in mathematics ought to be reflected by a similar gap in theological reflection. The closest it comes to being addressed is in a remarkable passage in the Second Book of Maccabees. It recounts the story of a Hebrew mother encouraging her son to endure martyrdom. The author, writing about 125 B.C.E., presents her as arguing in terms taken from Greek Philosophy.

> Οὐκ οἶδ᾽ ὅπως εἰς τὴν ἐμὴν ἐφάνητε κοιλίαν, οὐδὲ ἐγὼ τὸ πνεῦμα καὶ τὴν ζωὴν ὑμῖν ἐχαρισάμην, καὶ τὴν εκάστου στοιχείωσιν οὐκ ἐγὼ διερρύθμισα·
>
> I do not know how you appeared in my womb; it was not I who endowed you with breath and life, I had not *the proportioning of your elements.*
> (2 Macc 7:22, emphasis added)

The word στοιχείωσιν (*stoicheiosin*) is one of these philosophical terms. Etymologically, it means "the action or result of operating with *stoicheia*." The latter are the letters of the alphabet. From Plato onwards, they also refer to the elements of which physical things are made.[6] In Greek mathematics, *stoicheia* are the elements of proof. "Proportioning" διερρύθμισα (*diarhythmiza*) is a technical term in philosophy, mathematics, and music. It means "putting into harmonious ratios" and was applied to the elements of the cosmos and to the elements in individual things, including the human body. When Pythagoras spoke of the cosmos as "rational," he meant that its elements could be proportioned in numerical relationships. The Pythagoreans applied this principle to musical harmonies with great success. One should note that in the technical language of philosophy—which is echoed here in scripture—the elements of the universe are numbers. These in turn are the letters of the alphabet, and do not include zero.

In 2 Macc 7:22, the "elements" are the constituent parts of the human body, which God knits together in their proper proportion within the womb. In another verse from the chapter, the mother states as follows:

> I ask you, my child, look upon the heaven and the earth and to contemplate all therein. I ask you to understand that it was *not after they existed* that God fashioned them, and in the same manner the human race comes to be.
> (2 Macc 7:28, empahsis added)

This verse was to be important in the eventual formulation of the doctrine of *creatio ex nihilo*. The mother is evidently trying to convince her son of the resurrection of the body. One philosophical objection to this religious concept is that the elements of the body are dispersed after death and, since they are reintegrated into other organisms, are not available to be brought together again. Yet, the mother argues that the restoring of existence cannot be less probable than the original creation of the universe and its ongoing history as exemplified in the reproduction of human life. Goldstein paraphrases this passage in these words:

> Do not be afraid to cease to exist. You will live again, for it was not after existing that the world was created or that you yourself first came to be.[7]

Since the creation of all things is here explicitly paralleled with human conception, it is unlikely that the biblical author had it in mind to suggest that creation came from nothing. The ancients knew that a child in the womb did not come from nothing.[8]

For this reason, the latter text from Maccabees does not constitute an unequivocal argument on behalf of *creatio ex nihilo*. Goldstein, along with other biblical scholars, asserts that there is no such unambiguous affirmation of the doctrine in the Bible.[9]

The century after the completion of the Christian scriptures was to see an unrecognized development in mathematics and well-acknowledged one in theology. Astronomy was considered as part of mathematics, and Claudius Ptolemy (c. 85 – c.165) was one of the most influential of the Greek astronomers. His *Almagest* shares with Euclid's *Elements* the glory of being the scientific text longest in use. The original Greek title of Ptolemy's work translates as "The Mathematical Compilation," but this was soon replaced by the Greek for "The Greatest Compilation." Rendered into Arabic as "Al-majisti," it was later translated from Arabic into Latin and entitled *Almagest*. This work, published about 130 C.E., gives a mathematical theory of the motion of the sun, moon, and planets. Included in its thirteen volumes are astronomical observations and tables of trigonometric functions. To write these Ptolemy used the Babylonian sexagesimal system, transposed into Greek letter-numerals. The direct descendant of this system was the degrees-minutes-seconds that was used for angular measure up until this generation. An angle of 29° 4' 30" would have been written by Ptolemy as κθ δ λ. In the cases where there were zero minutes, Ptolemy used a circle symbol as a place-holder, 29° 0' 30" as κθ ο λ, possibly because, having a numeric value of 70, omicron cannot be mistaken for a digit in a base-60 number system. At first glance, this would appear to be the invention of zero, but Ptolemy employs the symbol only as a kind of punctuation mark in an otherwise confusing number. It is not used by itself to express the number zero. Mathematicians ignored the significance of his usage. Only a few astronomers used the notation, and it fell out of use several times before finally establishing itself.

An appreciation of the mathematics of the cultures of the biblical authors is an advantage in the attempt to understand their worldview.

Near the time that mathematicians almost discovered zero, theologians brought the "nothing" before creation into sharp focus.

In *The Shepherd of Hermas*, written about 140 C.E., is found the phrase, "God, who dwells in the heavens, and made out of nothing the things that exist" (1:6). Moreover the clumsy Greek phrase ουκ εξ όντων (not after they existed) of 2 Macc 7:28 became "*ex* *nihilo*" (from nothing) in the Old Latin translation made some time before 200 C.E. St. Jerome would likewise translate the verse as follows:

> *Peto, nate, ut aspicias ad coelum, et terram, et ad omnia quae in eis sunt: et intelligas, quia ex nihilo fecit illa Deus, ex hominum genus.*[10]

Whatever the intention of the author, the text was read as a clear assertion of *creatio ex nihilo.*

Tertullian, writing about 200 C.E., discussed the creation of good and evil, in dispute with Hermogenes, and used the phrase *ex nihilo* when he suggested that "if good was formed out of nothing, why not all things?"[11]

The clearest witness to the Patristic understanding of creation comes from Origen (c. 185-254). He stated the point of view he was opposing, indicated that he expressed the view "of believers" and gave his sources for the teaching:

> In the third place a beginning may be that out of which a thing comes, the underlying matter from which things are formed. This, however, is the view of those who hold matter itself to be uncreated, a view which we believers cannot share, since we believe God to have made the things that are out of the things which are not, as the mother of the seven martyrs in the Maccabees teaches, and as the angel of repentance in the Shepherd inculcated.[12]

Origen also had an extremely focussed conception of a "complete absence" before creation:

> But that we may see the nature of things a little more clearly, let it be granted that for a little time matter did not exist, and that God, when nothing formerly existed, caused those things to come into existence which He desired.[13]

Thus, from at least the third century of the Common Era, the doctrine concerning *creatio ex nihilo* was understood as clearly stated in the Hebrew scriptures.

For the subsequent centuries until the scholastic period, therefore, there was no urgency that a Council explicitly define what the Bible unequivocally asserted. Only in reaction to Albigensian teachings did Lateran IV address the idea in 1215 C.E. It was not treated as a new doctrine requiring a precise definition, but was included in a creed along with well-established Christian tenets.

Against this background the hypothesis that sparked this research seems unfounded. The possibility that *creatio ex nihilo* emerged in theology because of the developments in twelfth-century mathematics cannot be sustained. The roots of the dogmatic statement of the Lateran Council go back for at least a millennium and are thus independent of the mathematical developments in India. However, the suggestion that "nothing" is an elusive concept, seems to be borne out. The Scriptures do not unequivocally assert *creatio ex nihilo*, and do use functional circumlocutions for non-existence. Moreover the influence of philosophical and mathematical thought is apparent in the very passage which has been central to the development of the Christian teaching about creation. An appreciation of the mathematics of the cultures of the biblical authors is an advantage in the attempt to understand their worldview.

The idea of "nothing" is of importance in mathematics and theology. In mathematics it is the origin that our numbers radiate from, the one number that is neither positive nor negative, that belongs at the intersection of the real and imaginary axes. In theology the teaching that God created the universe *ex nihilo* was in opposition to theories that the universe was a kind of automatic emanation from the godhead. Focussing on that nothing at the beginning of everything has given theologians, like Jürgen Moltmann, for example, a strong appreciation of the liberty of God. Creation out of nothing cannot be compelled by anything, it can only be freely chosen.

The emergence into prominence of "nothing" in mathematics and theology in the twelfth century was not the result of a simple direct influence at that point in time. However, the history of the idea suggests the possibility of more subtle interactions between religion and what St. Gregory of Nyssa (c. 335–394) described as

> …the studies which sharpen the mind towards moral excellence: geometry, and astronomy, and the knowledge of the truth that the science of numbers gives, and every method that furnishes a proof of the unknown and a conviction of the known.[14]

Figure 1. Genesis 1:1

In the beginning	בראשית
created	ברא
God	אלהימ
the heavens	את השמים
and the earth	ואת הארצ
the earth	והארצ
was	היתה
without form	התהו
and void	ובהו
and darkness	וחשך
upon the face of	על פני
the deep	תהום

Figure 2. The Hebrew Number System

1	א	alef
2	ב	bet
3	ג	gimel
4	ד	daled
5	ה	he
6	ו	vav
7	ז	zayin
8	ח	chet
9	ט	tet
10	י	yod
20	כ	kaf
30	ל	lamed
40	מ	mem
50	נ	nun
60	ס	samek
70	ע	ayin
80	פ	pe
90	צ	tsadi
100	ק	qof
200	ר	reysh
300	שׁ	sin
400	ת	tav
500	תק	

Figure 3. The Greek Number System

1	α	alpha
2	β	beta
3	γ	gamma
4	δ	delta
5	ε	epsilon
6		vau*
7	ζ	zeta
8	η	eta
9	ψ	theta

*vau, koppa, and sampi are obsolete characters.

Works cited:

Allard, A. "*La diffusion en occident des premières oeuvres latines issues de l'arithmétique perdue d'al-Khwarizmi.*" *J. Hist. Arabic Sci.* 9, nos. 1-2 (1991): 101-105.

Bauer, Walter. *A Greek-English lexicon of the New Testament and Other Early Christian Literature.* Trans. and adapt. William F. Arndt and F. Wilbur Gingrich. 4th ed. Chicago: University of Chicago Press, 1957.

Goldstein, J. A. *II Maccabees: A New Translation with Introduction and Commentary.* Anchor Bible Series, vol. 41A. Garden City, N.Y.: Doubleday, 1983.

Gregory of Nyssa. *On Infants' Early Deaths.*

McLuhan, Marshall. Lecture at Florida State University, [complete date] 1970. the text of which can be found at URL: <www.videomcluhan.com/lectures.htm>, 2000.

McQuillin, Kristen. "A History of Zero." URL <http://users.telerama.com/~kristen/zero/zero.html>, 1997.

O'Connor, J., and E. Robertson. "A History of Zero." <www-history.mcs.st-andrews.ac.uk/~history/HistTopics/Zero.html>, 2000.

_____. "Abraham ben Meir ibn Ezra." URL <www-history.mcs.st-andrews.ac.uk/~history/Mathematicians>, 1999.

_____. "Abu Ja'Far Muhammad ibn Musa Al-Khwarizmi." URL <www-history.mcs.st-andrews.ac.uk/~history/Mathematicians>, 1999.

_____. "Claudius Ptolemy." URL <www-history.mcs.st-andrews. ac.uk/~history/Mathematicians>, 1999.

Origen. *Commentarius in Johannem.*

_____. *De Principiis.*

The Shepherd of Hermas, Revelations to . Compiled by Robert Van de Weyer. Liguori, Mo.: Triumph Books, 1997.

Tanner, Norman, ed. *Decrees of the Ecumenical Councils.* London: Sheed & Ward, 1990.

Tertullian. *The Treatise Against Hermogenes.* Translated and annotated by J. H. Waszink. Ancient Christian Writers Series: The Works of the Fathers in Translation, no. 24. Westminster, Md.: Newman Press, 1956.

Endnotes:

1. Allard, p. 103

2. Emphasis added. "*Firmiter credimus et simpliciter confitemur, quod unus solus est verus Deus, aeternus et immensus, omnipotens* [...] *qui sua omnipotenti virtute simul ab initio temporis, utramque de nihilo condidit creaturam, spiritualem et corporalem, angelicam videlicet et mundanam...*" (Tanner, p. 230).

3. Cf. Ps 6:5.

4. McLuhan.

5. As quoted by McQuillin.

6. Arndt, p. 776.

7. Goldstein, p. 309.

8. Goldstein refers to pp. 18-79 in *A History of Embryology*, by Joseph Needham (New York: Abelard-Schuman, 1959).

9. Goldstein, p. 307.

10. Jerome.

11. Tertullian, XV.

12. Origin, *Commentarius in Johannem* i 17.103.

13. Origin, *De Principiis* II 1.4.

14. Gregory of Nyssa.

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New World Order: Kauffman and Lonergan on the Emergence of Order in an Evolutionary Universe

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Stuart Kauffman argues that Darwinian natural selection cannot account for the spontaneous order of self-organized systems. This paper looks in detail at two of Kauffman's claims: (1) that life is an emergent property of autocatalytic sets of chemicals; and (2) that the ontogenetic development of living organisms is an emergent property of complex networks of genes. The author suggests that there are parallels between Kauffman's ideas about "emergent properties" and Bernard Lonergan's notion of "emergent probability." He then briefly explores the different ways in which their work on the emergence of order in the universe raises religious questions.

What might a Roman Catholic theologian and a theoretical biologist have in common? While at first glance there would seem to be little of substantive interest connecting the work of Bernard Lonergan and Stuart Kauffman, I want to argue that there are strong affinities between their projects. Exploring these affinities will mean looking in some detail at their understanding of the sources of order in the universe. From the problem of the origin of life to the morphogenesis of developing organisms, Kauffman finds this order emerging in ways that challenge the gradualism of Darwinian natural selection. Lonergan's work on the worldview of modern empirical science, which he terms "emergent probability," converges in surprising ways with Kauffman's work. To understand this convergence, one must first examine these thinkers in the context of their respective enterprises.

Bernard Lonergan (1904-1984) was a Jesuit philosopher and theologian whose professional career was spent teaching theology in Roman Catholic universities. Since the Second Vatican Council, there has been a widespread collapse of the neoscholastic paradigm for theological studies that had been dominant within Roman Catholic circles. Yet Lonergan had already become aware of the untenability of this paradigm several decades before Vatican II. He located the root of the difficulty in the inability of neoscholastic theology to deal with the methods of both the natural sciences and the critical historical sciences, and he made his life's work the search for a theological methodology that could integrate these methods. While *Method in Theology* (1972) remains Lonergan's mature articulation of such a theological methodology, it is in large measure dependent on the foundation laid in his earlier work, *Insight: A Study of Human Understanding* (1957).

Lonergan intended *Insight* to be "an exploration of methods generally in preparation for a study of the method of theology." [1] Lonergan's fundamental strategy in this earlier work is to understand method—not just theological method, but all determinate methods, whether theological, historical, or scientific—as rooted in a set of invariant structures operative within the human subject. Thus, as part of his overall argument in *Insight*, Lonergan includes on the one hand an analysis of the operations which the scientist performs as a scientist—in other words, an account of scientific knowing—and on the other hand an explicit articulation of the worldview implied by this same account of scientific knowing. Lonergan's term for this worldview is "emergent probability." As I hope to show, aspects of Lonergan's notion of emergent probability—in particular his understanding of "schemes of recurrence," development, and finality—provide a point of contact with the work of Kauffman.

Stuart Kauffman is a recipient of the prestigious MacArthur Fellowship (1987-92), and is one of the founding members in 1984 of the Santa Fe Institute, a scientific research center devoted to the interdisciplinary study of the dynamics of complex phenomena. Here I will focus on his work as he presents it in his book, *At Home in the Universe: The Search for Laws of Self-Organization and Complexity* (1995), a somewhat popularized version of his earlier book, *The Origins of Order* (1993).

Kauffman is a theoretical, rather than an experimental, biologist. A tremendously creative thinker, he spends most of his time speculating on large-scale questions about such things as the origins of life, the structure of living organisms, and the behavior of complex systems from cells to global economies. As with many of the scientists engaged in study of the problems of complex dynamical systems, he exploits the power of the computer and the mathematical models and explorations that it makes possible; his "experiments" tend to be "*in silico*" rather than *in vitro*. He is primarily concerned, then, with asking questions, pursuing promising lines of inquiry, and hazarding provocative and tantalizing answers to the questions that he raises. The work of experimental verification he leaves for others. As such, he fills one important role within the ecology of scientific research. He is engaged in what philosophers of science would call the articulation of a paradigm[2] or the formulation of a scientific research programme.[3]

What is the new paradigm or research programme that Kauffman proposes? The leitmotif that runs through his work is the notion of spontaneous order in nature—"order for free" as he puts it repeatedly.[4] He is convinced that Darwinian natural selection in and of itself cannot account for the order observed in the universe. He proposes the following:

> [M]uch of the order in organisms may not be the result of selection at all, but of the spontaneous order of self-organized systems.[5]

He argues that much of the order within the universe is not the accidental outcome of chance processes, but emerges spontaneously, naturally, in ways that are only beginning to be understood. According to Kauffman, Darwinian natural selection is not wrong, but it is insufficient for understanding these sources of spontaneous self-organization. Yet a revision of the Darwinian worldview needs a conceptual framework that can embrace both selection and self-organization, in which biological evolution can be understood as both a "deeply historical process" and yet "lawlike at the same time."[6] So Kauffman sees his project as a search for such a conceptual framework. He proceeds by trying to identify "generic emergent properties" in which the whole of a complex system exhibits properties not possessed by any of its parts.[7]

Kauffman proposes to explore these "generic emergent properties" using three different examples. First, he takes up "the origin of life as a collective emergent property of complex systems of chemicals." Secondly, he investigates "the development of the fertilized egg into the adult as an emergent property of complex networks of genes controlling one another's activities." Finally, he explores the emergent properties of "the behavior of coevolving species in ecosystems that generates small and large avalanches of extinction and speciation."[8] The origin of life, the ontogeny of the organism, and the coevolution of linked populations: each exhibits emergent properties that Kauffman believes may point us toward laws of self-organization.

Autocatalytic sets as schemes of recurrence

As I alluded to above, one of the key aspects in Lonergan's notion of emergent probability is that of a "scheme of recurrence." What relevance this has to Kauffman's project will perhaps become clear in turning to the first issue that Kauffman takes up: his understanding of the origin of life as a collective emergent property of complex systems of chemicals. The central idea here is what Kauffman calls an "autocatalytic set." [9] He introduces the idea of an autocatalytic set as a way of answering the question of how it is that life emerges from non-life. But first he presents a thumbnail sketch[10] of the history of attempts to explain the emergence of life: Alexander Oparin's discovery that coascervates could provide high concentrations of simple organic molecules; Stanley Miller's demonstration that many of the fundamental building blocks of proteins could be synthesized abiogenically; Crick and Watson's discovery of the double-helix structure of DNA, and the subsequent discovery of the complex machinery of protein enzymes which mediates the work of DNA; finally, the idea that life could have begun in much the same way that nude RNA functions, without DNA or its mediating structure of protein enzymes. The general picture painted by these efforts is in accord with the assumptions of Darwinian gradualism: a slow accumulation of chance occurrences that eventually results in living organisms. In other words, life emerged simple and became complex.

Kauffman has a radically different vision from these previous attempts to explain the origin of life. He argues that life emerged complex and whole, and has remained so ever since. The linchpin for his argument is the idea that life emerges as a consequence of the catalytic closure characteristic of autocatalytic sets. The basic idea of an autocatalytic set is fairly easy to grasp. First of all, "autocatalytic" simply means self-catalyzing. Molecules are created through chemical reactions. These chemical reactions are capable of being catalyzed, or sped up, by other molecules. If the set of molecules formed through such catalyzed chemical reactions are themselves capable of catalyzing the very set of reactions that formed them, then the collection of such self-catalyzing molecular chemical reactions can be termed an autocatalytic set. Kauffman writes:

> At its heart, a living organism is a system of chemicals that has the capacity to catalyze its own reproduction. Catalysts such as enzymes speed up chemical reactions that might otherwise occur, but only extremely slowly. What I call a collectively autocatalytic system is one in which the molecules speed up the very reactions by which they themselves are formed: A makes B; B makes C; C makes A again.[11]

Cells, for instance, are autocatalytic sets, because

> except for "food molecules," every molecular species of which a cell is constructed is created by catalysis of reactions, and the catalysis is itself carried out by catalysts created by the cell.[12]

The cell, however, is an enormously complex network of chemical reactions among roughly 100,000 different kinds of molecules. It thus seems unlikely that such a vast network of autocatalytic chemical reactions could emerge spontaneously. What Kauffman labors to demonstrate is the possibility that an autocatalytic set could emerge spontaneously given sufficiently high numbers of chemicals in suf-

I want to shift attention to the similarity between Kauffman's notion of collectively autocatalytic sets and what Lonergan calls schemes of recurrence.

ficiently high concentrations. His argument depends on precisely establishing the conditions for the emergence of such autocatalytic molecular systems, and then asking whether such conditions can indeed be fulfilled.

Furthermore, Kauffman has to show that such systems (which so far lack DNA) are capable of reproduction, and that such reproducing entities are capable of Darwinian evolution through natural selection. These arguments take up the bulk of chapters two through four. In the end, Kauffman thinks he has made a good case for the plausibility of such a theoretical model of the origins of life. As I mentioned above, the further work of scientific experimentation and verification remains to be done. Autocatalytic sets may or may not be the final solution to the mystery of the origin of living systems from nonliving collections of chemicals, but they are certainly an intriguing possibility. The point I want to make does not have to do with the likelihood of whether or not Kauffman is right. Instead, I want to shift attention to the similarity between Kauffman's notion of collectively autocatalytic sets and what Lonergan calls schemes of recurrence.

The heart of this comparison is the notion of reflexivity. Autocatalytic sets are reflexive because they are able to catalyze the very reactions that produce the catalysts in the first place: "A makes B; B makes C; C makes A again." But this reflexivity underlies Lonergan's notion of a scheme of recurrence as well. Lonergan's notion of a scheme of recurrence is that of a series of events which are (1) conditioned, and for which (2) the conditions link up to form a closed circuit. Lonergan writes:

> The notion of the scheme of recurrence arose when it was noted that the diverging series of positive conditions for an event might coil around in a circle. In that case, a series of events A, B, C,...would be so related that the fulfillment of the conditions for each would be the occurrence of the others. Schematically, then, the scheme might be represented by the series of conditionals: If A occurs, B will occur; if B occurs, C will occur; if C occurs, ...A will recur. Such a circular arrangement may involve any number of terms, the possibility of alternative routes, and in general any degree of complexity.[13]

As Kenneth Melchin suggests,

> The basic insight at the center of Lonergan's notion of the recurrence scheme is that of reflexivity.[14]

Kauffman's description of autocatalytic sets and Lonergan's notion of schemes of recurrence are clearly congruent with one another.

But while this reflexivity provides a point of comparison, there is also a point of difference. Kauffman's autocatalytic set stands as a particular instance of Lonergan's more general notion. Lonergan suggests several examples of schemes of recurrence:

> In illustration of schemes of recurrence the reader may think of the planetary system, of the circulation of water over the surface of the earth, of the nitrogen cycle familiar to biologists, of the routines of animal life, of the repetitive economic rhythms of production and exchange.[15]

A scheme of recurrence is thus a highly generalized or generic notion, capable of the widest application.

This difference between particular instance and generalized notion is rooted in the difference between Kauffman's and Lonergan's respective projects. In order to deepen my comparison of Kauffman and Lonergan, I would like to try and sketch the broader context for both autocatalytic sets and schemes of recurrence. The two notions are answers to two different kinds of questions. Kauffman is asking the question: what is the way in which life emerged from non-life? He introduces autocatalytic sets as a plausible answer to this question. In short, he is seeking determinate knowledge about the world (even if he presupposes a division of scientific labor by leaving the process of verification to others).

Lonergan, on the other hand, is asking a different question. He wants to understand both the scientist's knowing, as well as the structure of the scientifically known.

Lonergan's question thus has two sides to it: (1) what does a scientist do when he or she knows something scientifically? and (2) what is the general structure of the world, not as it is known through any determinate results of scientific investigation, but as it is known heuristically through the structures of scientific knowing?

What does this mean? Lonergan's analysis of scientific knowing focuses on the cognitional activities of the scientific knower. What he discovers is that scientific inquiry is rooted in what he calls "the unrestricted desire to know," the human capacity to wonder, to ask questions about anything and everything. But questions are one thing; answers are another. Modern empirical science has developed powerful methods—Lonergan calls them heuristic structures—for guiding this process of asking and answering questions. Heuristic structures are ways of moving from the unknown to the known. Just as in algebra, one names the unknown "x" in order to name its properties, to combine those properties in equations, and finally to solve the equations for a specific values of "x", so modern empirical science has developed heuristic structures for naming the unknown.

Lonergan's analysis of scientific knowing focuses on the cognitional activities of the scientific knower. What he discovers is that scientific inquiry is rooted in what he calls "the unrestricted desire to know," the human capacity to wonder.

Lonergan focuses on two of these structures in particular, which he terms classical and statistical heuristic structures. Both classical and statistical investigations seek to understand the "immanent intelligibility" of the universe, but they do so in different ways. Classical investigations seek insight into systematic processes through "the correlation of measurements by means of mathematical functions." [16] These insights are generally expressed as physical laws. This is the sort of heuristic structure employed by Galileo in his law of falling bodies ($d = \frac{1}{2} Gt^2$) or by Maxwell in his laws of electromagnetism. The work of statistical investigators, on the other hand, may be understood in the following terms:

> [S]tatistical investigations provide a scientific account of nonsystematic processes by searching for the probabilities with which events occur, while abstracting from the random differences from those probabilities.[17]

Lonergan has in mind here 19th-century developments in thermodynamics and the kinetic theory of gases, and 20th-century developments in quantum theory. These two types of investigation and their resultant intelligibilities are complementary:

> [C]lassical laws tell what would happen if conditions were fulfilled; statistical laws tell how often conditions are fulfilled.[18]

Lonergan's notion of a scheme of recurrence enters in here as a way of linking classical and statistical intelligibility into a unified whole. The key points are as follows:

(1) events occur;

(2) these events have probabilities of occurring;

(3) some events are systematically linked to others by classical laws;

(4) in certain cases events with their respective probabilities can be linked in cycles, or schemes of recurrence, by virtue of their systematic, classical connections;

(5) these schemes of recurrence themselves have probabilities of occurring;

(6) both events and schemes of recurrence have conditions; and

(7) some schemes of recurrence function as the conditions for other schemes.

This linkage of classical and statistical intelligibility through the notion of schemes of recurrence results in the powerful explanatory structure which Lonergan terms "emergent probability":

> It results from the combination of the conditioned series of schemes with their respective probabilities of emergence and survival. While by itself it is extremely jejune, it possesses rather remarkable potentialities of explanation.[19]

For Lonergan, the universe is fundamentally characterized by emergent probability. The universe unfolds through the myriad interlinking of physical, chemical, biological and psychic schemes of recurrence. Furthermore, emergent probability is no less operative in human history than it is in the natural world. In essence, much of the latter half of *Insight* consists of Lonergan's attempts to explore the significance of emergent probability for human history, including the human good. Emergent probability is clearly a key idea for Lonergan. What I want to suggest here is that just as Kauffman's notion of an autocatalytic set invites comparison with Lonergan's notion of a scheme of recurrence, so Kauffman's use of emergence invites comparison with emergent probability. As I pointed out above, Kauffman believes that the origin of life, the ontogeny of the organism, and the coevolution of linked populations all exhibit emergent properties.

Just as Kauffman's notion of an autocatalytic set invites comparison with Lonergan's notion of a scheme of recurrence, so Kauffman's use of emergence invites comparison with emergent probability.

Reductionism, holism, and emergent probability

A recurring theme in Kauffman's book is the notion of emergence, a theme that refers to the relationship between the parts and the whole. One of his central intuitions is that reductionism is not ultimately an adequate strategy for understanding the biological world:

> The reductionist program has been spectacularly successful, and will continue to be so. But it has often left a vacuum: How do we use the information gleaned about the parts to build up a theory of the whole? The deep difficulty here lies in the fact that the complex whole may exhibit properties that are not readily explained by understanding the parts. The complex whole, in a completely nonmystical sense, can often exhibit collective properties, 'emergent' features that are lawful in their own right.[20]

Darwinian natural selection is a reductionistic attempt to account for biological order. In Kauffman's estimation, it is, therefore, ultimately insufficient and needs to be complemented by an account of the whole in biological systems. For Kauffman, the order of self-organized systems is an emergent order. Life "emerges" as a property of catalytic closure in chemical sets. Similarly, as I shall point out below, ontogeny—or more precisely, cell differentiation and morphogenesis—emerges as a property of genomic networks. This idea of emergent properties is at the very heart of Kauffman's notions of "order for free" and laws of self-organization.

Lonergan shares with Kauffman this fundamental intuition about the inadequacy of reductionism and the importance of emergence. In his introduction to *Insight*, he says that part of the relevance of his treatment of mathematical physics in the opening chapters is to highlight "the significance of the transition from the old mechanism to relativity and from the old determinism to statistical laws."[21] In Lonergan's view, scientific developments themselves have made a strict mechanism or determinism untenable. Still, not all branches of scientific investigation or all scientists have made this realization explicit, so part of the function of his idea of metaphysics as "the integral heuristic structure of proportionate being"[22] is to enable a systematic exposure of the limitations of mechanist and determinist assumptions and to effect their reversal. Emergent probability, then, is a way of talking about the worldview presupposed by scientific investigation, but a way that avoids mechanist or determinist assumptions.

Emergent probability gives Lonergan a way of talking about emergence that is precise yet highly generalized. As is characteristic of Lonergan's way of proceeding, emergence takes its fundamental meaning from cognitional theory. Here Lonergan talks about the integration of elements of an image through an insight:

> The prototype of emergence is the insight that arises with respect to an appropriate image: without the insight, the image is a coincidental manifold; by the insight the elements of the image become intelligibly united and related; moreover, accumulations of insights unify and relate ever greater and more diversified ranges of images, and what remains merely coincidental from a lower viewpoint becomes systematic from the accumulation of insights in a higher viewpoint.[23]

While Lonergan here uses the example of an insight or set of insights that systematize the otherwise merely coincidental image or ranges of images, such a notion of emergence can be generalized to include any number of successively higher integrations. An autocatalytic set can be understood as just such a higher integration of a lower chemical manifold. While each and every chemical reaction is related to its predecessors by classical laws, the intelligibility of the whole recurring set goes beyond the intelligibility of each event in the set.

Such a meaning for emergence, worked out within the context of a basic set of terms and relations, is lacking in Kauffman. Emergence is clearly a notion that bears a heavy philosophical burden in Kauffman's work, but besides his frequent remark that his understanding of emergence is "nonmystical," he is somewhat at a loss to explain what he means, other than by providing examples such as his idea that life is an emergent property of autocatalytic sets, or that ontogeny is an emergent property of genomic networks. Emergence is a central notion in *Insight* as well; but unlike Kauffman, Lonergan is able to provide an explanatory account of emergence, by means of which it is possible to work out its implications for understanding the universe. One of the implications of emergence, for both Kauffman and Lonergan, is that the universe is a developing universe, and so it is to Kauffman's exploration of the developing organism that I will turn next.

Ontogeny and development

The second topic Kauffman takes up in his investigation of generic emergent properties is the issue of ontogeny, "the development of the fertilized egg into the adult as an emergent property of complex networks of genes controlling one another's activities." Ontogeny, or development, has two aspects: cell differentiation and morphogenesis. In the cell differentiation that takes place in a human person, for instance, the descendants of a single zygote cell develop into 256 different cell types, each of which is specialized for a certain type of function within the body. Somewhere on the order of 10^{15} cells are formed through a series of 50 cell divisions. Morphogenesis refers to the organization and coordination of this vast number of cells into functioning tissues and organs. The obvious question is, how did such a magnificently complex and ordered process emerge?

The discovery of the gene, and later, DNA, led to what Kauffman calls the central dogma of developmental biology:

> Cells differ because different genes are active in the different cell types of the organism.[24]

But this leads to further questions:

> What is the mechanism that allows some genes to be active while others are suppressed? And how, as the zygote unfolds into the body, do the various cell types know which proteins to express?[25]

The next important step, according to Kauffman, was the work of Jacob and Monod in the mid-1960s, and their idea of genetic circuits, especially the idea that "action via second sites meant utter freedom from the molecular point of view to create genetic circuits of arbitrary logic and complexity."[26] Such a view is amenable to the Darwinian view that natural selection is the sole source of order. In this view, the pattern of ontogeny that leads to a human body is simply the result of the chance accumulation and selection of arbitrary genetic circuits.

Kauffman, as might be expected, is not satisfied with this explanation. He does not think it is sufficient to account for the actual order observed within the processes of ontogeny:

> Since each of our cells houses some 100,000 or more genes, the state space of the human genomic regulatory system is at least $2^{100,000}$ or $10^{30,000}$. As we have noted, this number is meaninglessly enormous compared with anything we know about. In terms of this vast state space, what is a cell type? The central dogma of developmental biology merely states that different cell types are different patterns of activity of the same genomic system. That is not much help when the human genome affords at least $10^{30,000}$ combinations of gene activity.[27]

In place of this central dogma, Kauffman proposes that cell types are basins of attraction within the genomic network. The vast state space of the genomic network was not explored in a purely random fashion; rather, it is pulled by a relatively small number of attractors.[28] Such basins of attraction should be able to resist perturbations; otherwise these cell types would lack the requisite homeostasis. On the other hand, this homeostasis cannot be absolute:

> If the zygote differentiates through branching pathways to intermediate cell types that themselves branch to the final cell types of the newborn or the adult, then occasionally a perturbation will have to push a cell into a new basin of attraction flowing to a new attractor—that is, into a new developmental pathway flowing to a new cell type.[29]

If Kauffman is right about genomic networks functioning as basins of attraction for cell types, then the process of ontogeny represents another example of "order for free."

A further question arises about the source of these perturbations in the first place. Is there a way in which the organism as a whole operates to condition which basins of attraction a cell might be pushed toward?[30] Kauffman does not address this question, but Lonergan's understanding of development suggests that this might be a fruitful line of inquiry to pursue. As has been shown, Lonergan introduces emergent probability as a way of integrating classical and statistical methods, but emergent probability also admits of further expansions to include both genetic method (which allows Lonergan to deal with development and change) and dialectical method (which allows him to deal with the distortions of human history). Genetic method deals with development, which Lonergan defines this way:

> ...a flexible, linked sequence of dynamic and increasingly differentiated higher integrations that meet the tension of successively transformed underlying

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manifolds through successive applications of the principles of correspondence and emergence.[31]

Development consists of a series of higher integrations of lower, otherwise coincidental manifolds, but if development is to be ongoing, such integrations must be dynamic. A higher integration is static when the lower manifold is dominated with complete success, so that the same systematic patterns keep recurring without modification or change.[32] Lonergan's example here is of the inert gases locking manifolds of subatomic events within permanent routines. One could also think of it in terms of Kauffman's absolute homeostasis within cell types that would preclude further differentiation. But according to Lonergan, when the higher integration is dynamic, there results an ongoing modification of the underlying manifold until a new integration emerges. Lonergan refers to the developing organism as an operator, because it "so integrates the underlying manifold as to call forth...its own replacement by a more specific and effective integrator."[33] As an operator, it seems likely that an organism might play at least a limited role in determining which developmental pathway a cell might follow. The developing organism is thus the ongoing linked series of increasingly differentiated integrations.

I hope I have shown that Lonergan's explanatory account of emergence, along with its implications for development, meshes nicely with Kauffman's explorations into the ontogeny of the organism. As was the case with the comparison between autocatalytic sets and schemes of recurrence, there is here, as well, an interesting convergence between the ideas of these two seemingly disparate thinkers. As I mentioned above, however, Kauffman has so far left the work of experimental verification to others. It is entirely possible, perhaps even likely, that Kauffman's theories are wrong. The point I want to emphasize here is that the validity of Lonergan's understanding of emergence and emergent probability in no way depends upon the correctness of Kauffman's ideas. Because Lonergan's account of emergent probability is based on the heuristic structures of empirical science (in other words, on the concrete performance of scientists), rather than on the determinate contents of particular scientific investigations, his account does not stand or fall with the eventual verification or falsification of Kauffman's theories.

Order for free and finality

In closing, I want to consider briefly the matter of how, for both Kauffman and Lonergan, reflection on an evolutionary world-order characterized by emergence opens out onto religious questions. Written as it is as a popularization of a body of scientific work, it would be easy to overlook Kauffman's more poetic flights in *At Home in the Universe*. But while such reflections may not offer much in the way of "hard science," still they express on the one hand a deep dissatisfaction with what he takes to be the implications of Darwinian natural selection, and on the other hand a deep-seated religious longing for meaning. Kauffman sees nihilism at the heart of Darwinian evolution:

> Science has left us as unaccountably improbable accidents against the cold, immense backdrop of space and time.[34]

Not that Kauffman is about to embrace institutionalized religion. Traditional religious belief he considers a non-option: "Paradise has been lost, not to sin, but to science." [35] For Kauffman, the rise of science means the demise of religious belief. Yet he holds out hope that although paradise has been lost to science, perhaps science can still wrest from the world a sense of the sacred:

> If we are, in ways we do not yet see, natural expressions of matter and energy coupled together in nonequilibrium systems, if life in its abundance were bound to arise, not as an incalculably improbable accident, but as an expected fulfillment of the natural order, then we truly are at home in the universe.[36]

The phrases "at home in the universe" and "we the expected" rather than "we the improbable" echo throughout the book, and lend

Kauffman's search for "order for free" not a little of its urgency.

Lonergan finished writing *Insight* in 1953, the same year Watson and Crick's paper on the double helix structure of DNA was published. In light of this, the applicability of Lonergan's ideas on genetic method is nothing short of astonishing. Lonergan, I have suggested, would find much in Kauffman's work to embrace. There is one final parallel that I wish to draw, namely, that for Lonergan no less than for Kauffman, the order of the universe opens out onto religious questions, albeit in significantly different ways. For what Kauffman terms "order for free" finds its counterpart in Lonergan's notion of finality, an "upwardly but indeterminately directed dynamism towards ever fuller realization of being." [37] But while Kauffman limits his search for the sacred to the universe accessible to the empirical sciences (what Lonergan would refer to as the universe of proportionate being), Lonergan allows for the unrestricted desire to know to raise the question of transcendent being: that is, is there something that explains the explainability of the universe of our experience? And to raise that question is already to be engaged in a search for God.

Works cited:

Byrne, Patrick H. "God and the Statistical Universe." *Zygon* 16, no. 4 (December 1981): 345-63.

Kauffman, Stuart. *The Origins of Order: Self-Organization and Selection in Evolution.* New York: Oxford University Press, 1993.

_____*At Home in the Universe: The Search for Laws of Self-Organization and Complexity.* Oxford: Oxford University Press, 1995.

Kuhn, Thomas. *The Structure of Scientific Revolutions.* 2nd ed. Chicago: University of Chicago Press, 1970.

Lakatos, Imre. "Falsification and the Methodology of Scientific Research Programmes." In *Criticism and the Growth of Knowledge*, ed. by Imre Lakatos and A. Musgrave, 91-196. Cambridge: Cambridge University Press, 1970.

Lonergan, Bernard. *Insight: A Study of Human Understanding.* Vol. 3 of *Collected Works of Bernard Lonergan*, ed. by Frederick E. Crowe and Robert M. Doran. Toronto: University of Toronto Press, 1992 [1957].

_____. *A Second Collection.* Ed. William F. J. Ryan and Bernard J. Tyrrell. Philadelphia: Westminster Press, 1974.

Melchin, Kenneth R. *History, Ethics and Emergent Probability: Ethics, Society and History in the Work of Bernard Lonergan.* Lanham, Md.: University Press of America, 1987.

Endnotes:

1. Lonergan, *A Second Collection*, p. 268.

2. See Kuhn.

3. See Lakatos. Roughly speaking, Lonergan might say that Kauffman operates primarily at the level of formulating insights, while leaving the task of judgment to others. While this remark invites a comparison of Lonergan's account of scientific rationality with that of other figures in the philosophy of science, I will prescind from this task in order to deal at greater length with other issues.

4. Kauffman, *At Home in the Universe*, pp. 71-95 passim.

5. Ibid., p. 25.

6. Ibid., p. 14.

7. Ibid., p. 24.

8. Ibid., p. 19.

9. Ibid., ch. 3.

10. Ibid., ch. 2.

11. Ibid., p. 49.

12. Ibid., p. 50. See figure 3.1 (p. 49) and figure 3.7 (p. 65) for schematic representations of autocatalytic sets.

13. Lonergan, *Insight*, p. 141.

14. Melchin, p. 105.

15. Lonergan, loc. cit.

16. Byrne, p. 349.

17. Ibid., p. 357.

18. Lonergan, op. cit., p. 131.

19. Ibid., p. 145.

20. Kauffman, op. cit., pp. vii-viii.

21. Lonergan, op. cit., p. 15.

22. Ibid., pp. 415-21.

23. Ibid., p. 506.

24. Kauffman, op. cit., p. 95.

25. Ibid.

26. Ibid., p. 97.

27. Ibid., p. 106. The recently completed sequence of the human genome puts the number of genes closer to 30,000, but Kauffman's point remains valid. See "The Newly Sequenced Genome Bares All," by J. Netting and L. Wang, *Science News* 159, no. 7 (17 Feb. 2001): 100-101.

28. For an introduction to attractors and attractor basins, see *Chaos: Making a New Science*, by James Gleick (New York: Penguin Books, 1987), pp. 119ff. and 233-36.

29. Kauffman, op. cit., p. 110.

30. This question was suggested to me by Patrick Byrne during a "God and the World of the Sciences" seminar meeting at the Jesuit Institute at Boston College on 25 March 1999.

31. Lonergan, op. cit., p. 479.

32. Ibid., p. 477.

33. Ibid., p. 490.

34. Kauffman, op. cit., p. vii.

35. Ibid., p. 4.

36. Ibid., p. 20.

37. Lonergan, op. cit., p. 477.

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Stephen Hawking's *A Brief History of Time* and the Teleological and Cosmological Arguments

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The author argues that Stephen Hawking makes implicit reference to and attempts to undermine two classical arguments for the existence of God: the teleological and the cosmological arguments. Further, the author shows that, in fact, Hawking's "No Boundary Proposal"—even if it were to be empirically verified—would not entirely discredit these two arguments, but would, instead, transform them into epistemic icons that reveal the immanent presence of God in the cosmos.

Stephen Hawking's *A Brief History of Time* is "a book about God—or perhaps about the absence of God." So says the late Carl Sagan in his introduction to the book. According to Sagan, Hawking presents to his readers "a universe with no edge in space, no beginning or end in time, and nothing for a Creator to do."[1] Given the fact that Hawking repeatedly intimates that cosmology leaves scientists with serious doubts about the existence of God, Sagan's reading of the book seems to be a fair one.

A Brief History of Time can be taken as an extended argument for Hawking's famous "no boundary proposal" (NBP). Common sense dictates that the universe is either infinite in age and without boundary, or else finite in age with a boundary at a singularity.[2] In flagrant violation of common sense, Hawking's proposal states that the universe is both finite and edgeless (without a singularity). The first seven chapters of Hawking's book lay out the essential evidence for the NBP. Hawking describes advances in physics during this century, making special note of confirmations of quantum mechanics and the general theory of relativity. These are the two theories upon which the NBP rests. It is in fusing these two theories[3] that Hawking hopes to make a case for the NBP.

But how does the NBP relate to Hawking's insinuation of God's absence? The following paper is an attempt to answer this question. According to Hawking, "if the universe is completely self-contained, with no singularities or boundaries, and completely described by a unified theory, that fact has profound implications for the role of God the creator."[4] The reader is to assume, I think, that these implications are almost entirely negative for God. Joseph Zycinski puts it this way, "cosmological edgelessness implies metaphysical denial of the existence of God." [5] Hawking takes the NBP to be pointing to (hinting at) the absence of God in the universe. As Darwin seemingly forced the hand of God out of human creation, a century later Hawking seems to be forcing the hand of God out of universal creation.

I have serious doubts about the NBP's negative implications for God. I will argue here that, even if the reality of the NBP be admitted, that is a long way from removing God from the cosmos. But, before I argue that point I want to closely examine the context in which the NBP arises in *A Brief His-*

tory of Time. I am interested in the metaphysical mileage that Hawking gets out of the NBP. What I hope to show is that Hawking uses the NBP to fend off both the teleological and cosmological arguments for God's existence—arguments that immediately come to mind in light of the kind of physical evidence presented by Hawking in *A Brief History of Time*. It would be too much to say that Hawking, foreseeing the theistically tinged implications of the physical evidence, dredges up the NBP deliberately to undercut the teleological and cosmological arguments. However, I think it is clear that Hawking, although he doesn't explicitly mention them, is conscious of these arguments throughout his discussion of the NBP. One could even read his discussion of the NBP as revolving around the teleological and cosmological arguments for God's existence.

In brief, it is my objective in this paper to argue the following points. Firstly, I hope to demonstrate that the NBP arises out of an attempt to circumvent the teleological and cosmological arguments. Secondly, I purpose to demonstrate that Hawking's arguments for the NBP are based on a misguided notion of the laws of nature. I will argue that he understands the laws of nature to have an unwarrantedly high ontological status and comprehensibility. Thirdly, I contend that even if Hawking is granted the reality of the NBP, the presence of God is still not excluded from the cosmos. Finally, I will recast the teleological and cosmological arguments for God's existence in light of the previous discussion. Rather than proving a wholly transcendent Creator God, I propose that these arguments are signals of God's immanence in the order of the universe.

As Hawking jettisons the point of singularity—the very theory that he was responsible for legitimating—he not only explains the existence of cosmic order without recourse to theism, but also diminishes the plausibility of a divine creation event.

In the eighth chapter of *A Brief History of Time*, Hawking introduces the NBP and uses it to explain, without recourse to theism, two perplexing physical phenomena: the existence of cosmic order[6] and the existence of a singularity. These two phenomena give rise to two traditional arguments for God's existence. Cosmic order gives rise to the teleological argument and a singularity gives rise to the cosmological argument. As I shall point out, Hawking's attempt to explain away the former (order) will eventually lead him to do away with the latter (singularity).

Hawking begins the eighth chapter by describing cosmic order. The initial high temperature of the universe, the critical rate of expansion of the universe, the near uniformity of the early universe, and the local irregularities in the early universe (which allow for the formation of stars and galaxies) are examples of cosmic order.[7] Hawking admits that cosmic order is colored with theistic possibility when he says, "one possible answer is to say that God chose the initial configuration of the universe."[8]

Hawking is certainly dealing with the teleological argument for God's existence. He never explicitly mentions the argument by name, but he gives wonderful expression to it at one point in the text:

> [I]t seems clear that there are relatively few ranges of values for the numbers that would allow for the development of any form of intelligent life. Most sets of values would give rise to universes that, although they may be beautiful, would contain no one able to wonder at that beauty. One can take this either as evidence of a divine purpose in Creation and the choice of the laws of science or as support for the strong anthropic principle.[9]

Although he is aware of the theistic implications of cosmic order, Hawking suggests that the strong anthropic principle (SAP)[10] might be adequate to explain the cosmic order.[11] However, Hawking rejects the SAP.[12] But having rejected it, Hawking does not stay true to his earlier either/or proposal. Instead, he attempts to circumvent theistic fine-tuning in another way. In order to minimize the improbability of the cosmic order, Hawking turns to the inflationary model[13] of the universe. The crucial characteristic of this model for this discussion is that it does not require fine-tuned initial conditions of the universe.

> Quite a number of different initial configurations for the universe would have evolved to produce a universe like the one we observe. If this is the case, a universe that developed from some sort of random initial conditions should contain a number of regions that are smooth and uniform and suitable for the evolution of intelligent life.[14]

This model undermines the teleological argument by positing an initial configuration in just the sort of chaotic state that would be expected from purely naturalistic assumptions. "This is important, because it shows that the initial state of the part of the universe that we inhabit did not have to be chosen with great care."[15]

After a thorough discussion of various inflationary models, Hawking concedes that none of them can completely explain the presence of cosmic order in our universe.

> [I]t cannot be the case that every initial configuration would have led to a universe like the one we observe. [...] There must have been initial configurations that would not have given rise to a universe like the one we see today. So even the inflationary model does not tell us why the initial configuration was not such as to produce something very different from what we now observe.[16]

So, the thorn in Hawking's flesh, the pugnacious fact of cosmic order, remains.

Hawking's discussion of cosmic order now becomes enmeshed in his singularity theorem. Cosmic order is linked to the singularity theorem in the following way. The absence of a singularity (the NBP) can account for the resiliently inexplicable cosmic order. How does the NBP explain the cosmic order? First of all, the laws of nature break down at a singularity, leaving us completely in the dark as to the initial conditions of the universe. But the NBP avoids this breakdown by removing the infinite conditions found at the point of singularity. So, given the NBP, the laws of nature apply across the whole universe. Secondly, if a theory of quantum gravity is the ultimate physical theory, and if it can span the whole universe, then it might be able to explain why we live in a universe that happens to have cosmic order. After all, the quantum theory of gravity predicts which history of the universe, among the many, is the most probable.

> Under the no boundary proposal one learns that the chance of the universe being found to be following most of the possible histories is negligible, but there is a particular family of histories that are much more probable than the others.[17]

Thus, the quantum theory of gravity (read in the context of the NBP) might show that a universe with cosmic order is by far the most probable universe.

The NBP, then, is a bold theoretical move. As Hawking jettisons the point of singularity—the very theory that he was responsible for legitimating[18]—he not only explains the existence of cosmic order without recourse to theism, but also diminishes the plausibility of a divine creation event.

> So long as the universe had a beginning, one could suppose it had a creator. But if the universe is completely self-contained, having no boundary or edge, it would have neither beginning nor end: it would simply be. "What place then for a creator?"[19]

Notice that the NPB kills two birds with one stone. Not only does it explain the cosmic order, but it also rids the universe of a theistically-pregnant singularity. Hawking is aware of these theistic implications within the singularity when he writes, "many people do not like the idea that time has a beginning, probably because it smacks of divine intervention."[20] With the NBP, Hawking removes these smatterings of divine intervention. He also accounts for the presence of cosmic order in a random universe.

As much as Hawking's NBP arises within the context of his rejection of the teleological and cosmological arguments for God's existence, I do not suggest that Hawking is motivated by these arguments to construct his NBP. Such a statement would require analysis of his inner thoughts. Nevertheless, a comment from Jane Hawking, Hawking's former wife, reveals something of his repugnance to theism:

> There doesn't seem to be room in the minds of people who are working out these things for other sources of inspiration. You can't actually get an answer out of Stephen regarding philosophy beyond the realms of science.[21]

If one really cannot get an answer out of Hawking beyond the realm of science, then the NBP is an ideal preservative for him. The NBP excises all extra-scientific elements from the discussion of the cosmos. Debate over the order and origin of the universe is hermetically sealed from meddling theologians. As has already been shown, the NBP also protects the laws of nature from breakdown at the singularity. So, protection from potential breakdown and preservation from unintelligible outside influences are significant philosophical aspects of the NBP. Both functions ensure the final intelligibility of the laws of nature. To see how determinative this maintenance of intelligibility is for Hawking's NBP requires a few quotations from his book.

• Hawking assumes that positing God is inextricably bound to positing an "initial configuration of the universe—that we cannot hope to understand." [22]

• Hawking complains that "if [God] had started it off in such an incomprehensible way, why did he choose to let it evolve according to laws that we could understand?"[23]

• Hawking reasons that "it would be only natural to suppose that—order should apply not only to the laws [of nature], but also to the conditions at the boundary of space-time that specify the initial state of the universe."[24]

• Hawking writes, "in order to predict how the universe should have started off, one needs laws that hold at the beginning of time."[25]

• Hawking constantly avoids what he calls "a counsel of despair, a negation of all our hopes of understanding the underlying order of the universe."[26]

• In Hawking's analogy of the universe to the globe, he hopes that "the laws of science will hold at the [beginning and end of the universe], just as they do at the North and South Poles on the earth."[27]

• Hawking's great hope is that "if we find an answer to [the final laws of nature], it would be the ultimate triumph of human reason—for then we would know the mind of God."[28]

• Hawking makes the following argument for the complete comprehensibility of the laws of nature: "God could have started the universe off any way he wanted. But in that case he also could have made it develop in a completely arbitrary way. Yet it appears that he chose to make it evolve according to certain laws. It therefore seems equally reasonable to suppose that there are also laws governing the initial state."[29]

• Hawking hopes that "the eventual goal of science is to provide a single theory that describes the whole universe."[30]

• Hawking bemoans the fact that "at the singularity, general relativity and all other physical laws would break down: one couldn't predict what will come out of the singularity."[31]

It is clear from these quotations that Hawking is dedicated to laws of nature that are intelligible and unbreakable. But why is he so loathe to entertain the possibility that the laws of nature, fallible human constructions of reality, might be interfered with or broken? The answer is that Hawking does not think that the laws of nature are fallible human constructions of reality. More often than not, in his discussions of the laws of nature, Hawking's view is neo-Platonic. Zycinski labels this belief necessitarian, in that it holds that the essence of the laws of nature cannot be reduced to mere human observations of regularity. The necessitarian tradition "presupposes the existence of hidden necessary links that constitute the order of nature."[32] So, instead of human best guesses, approximate descriptions of the regularity observed in nature, Hawking believes that the laws of nature are fixed, real, independently-existing entities that prescribe what events must occur. From the above quotations, it obvious that this neo-Platonic view is Hawking's predominant reading of the laws of nature. Given this understanding, it is clear why Hawking would not want the laws to be broken.

The final test of the "no boundary proposal," as Hawking admits, will be scientific—whether it can explain existing phenomena or accurately predict new phenomena; it will not be philosophical.

Hawking's determination to preserve and protect the laws of nature is problematic for two reasons. First, Hawking is not consistent within his own treatment of the laws of nature. Secondly, he naively assumes an unwarrantedly high view of the laws of nature.

To begin, Hawking generally believes that the laws of nature are far more than concepts in the human mind. And yet, at the beginning of *A Brief History of Time*, he writes the following:

> [A] theory is just a model of the universe, or a restricted part of it, and a set of rules that relate quantities in the model to observations that we make. It exists only in our minds and does not have any other reality (whatever that might mean).[34]

Also, when Hawking needs to show that imaginary time might be just as real as so-called real time, he conveniently relativizes the laws of nature.

> So, maybe what we call imaginary time is really more basic, and what we call real is just an idea that we invent to help us describe what we think that universe is like. But according to the approach I described in Chapter 1, a scientific theory is just a mathematical model we make to describe our observations: it exists only in our minds.[35]

Hawking seems to be playing metaphysical ping-pong with the laws of nature. Do they exist only in our minds or are they inviolable, the very warp and woof of creation? If they are only mathematical models, then are they really worth preserving and protecting by constructing the NBP?

Even if allowances are made for the inconsistencies in Hawking's treatment of the laws of nature, it is hard to excuse his naive statements about their high ontological status. If Hawking is going to treat the laws of nature as binding realities that can never be broken, then he needs to make an argument for it. This contention is especially true in light of the multiple critiques of a neo-Platonic view of the laws of nature in the last forty years. One such critique comes from William Stoeger. In a paper entitled "Quantum Cosmology and the Laws of Nature," Stoeger lists at least five reasons to doubt a neo-Platonic reading of the laws of nature.[36] I simply list them here, without explication:

1. We observe the laws of nature with limited/indirect instruments.

2. The laws of nature are always idealized from experimental data. The data never quite fit the theory.

3. The laws of nature are always underdetermined by the data that they explain. Several contradictory theories could often account for the same data.

4. The history of science shows that cultural presuppositions, human creativity, and reigning paradigms play a crucial role in the creation of theories.

5. The history of science shows that long-established laws of nature are constantly being subsumed or replaced by new laws.

Although I will not draw out here a balanced theory of the laws of nature based on these five arguments, I think that they are sufficient to undercut Hawking's assumptions.

To summarize, a critical role of Hawking's NBP is to circumvent teleological and ontological reasoning for the existence of God; the NBP is deeply motivated by Hawking's desire to preserve and protect his high view of the laws of nature; and finally, Hawking's high view of the laws of nature is deeply problematic. To return to my basic concern in this essay, one way of relating the NBP to the question of God's existence is to reject the NBP on grounds of faulty reasoning. What I have just summarized seems to legitimate that claim. Argumentative theists could take what I have just said and use it as a polemic against the NBP.

The cosmological argument, instead of being a proof for a cosmic jump-starter, becomes an icon pointing the way to the presence of the immanent God, who constantly upholds, sustains, and makes real a creation that would have no reality apart from God.

In spite of what I have just said, the final test of the NBP, as Hawking admits, will be scientific—whether it can explain existing phenomena or accurately predict new phenomena; it will not be philosophical. Thus, before I conclude with a re-examination of the teleological and cosmological arguments, I want to assume that the NBP is true, and to see how it relates to the question of God's existence. Unlike Hawking and Sagan, I think that one can take the view that the NBP and God's existence are cooperative "doctrines," rather than competitive ones.

One is forced to pit God and the NBP against one another, I think, only if one assumes what Zycinski calls a "Clarkean physico-theology in which the God of scientific gaps invented by Samuel Clarke is replaced by the God of cosmological edges." [37]

> Hawking's dictum "if there is no edge, there is no God, the Creator" expresses the essence of the same philosophy which we find in Clarke's gaps.[38]

The essence of both philosophies is that God operates only in realms unexplored by science. So, the more that science explains (say, at the edge of the cosmos), the farther God's activity recedes (beyond the boundary of the cosmos). If God really is only a magical explanation for all that is mysterious, then Hawking is right to say that the NBP deals a fatal blow to God as Creator, because one of the greatest mysteries of all—the existence of Creation, the cosmos—would be solved.

Thankfully, this Clarkean physico-theology need not be accepted. It would be more theologically adequate to agree with Arthur Peacocke:

> God is *semper* Creator—God is creating now and continuously in and through the inherent, inbuilt creativity of the natural order, both physical and biological—creativity that is itself God in the process of creating.[39]

Paul Davies expresses the same idea with greater flourish.

> The idea of God who is just another force or agency at work in nature, moving atoms here and there in competition with physical forces is profoundly uninspiring. To me, the true miracles of nature are to be found in the ingenious and unswerving lawfulness of the cosmos, a lawfulness that permits complex order to emerge from chaos, life to emerge from inanimate matter, and consciousness to emerge from life, without the need for the occasional supernatural prod; a lawfulness that produces beings who not only ask great questions of existence, but who, through science and other methods of inquiry, are even beginning to find answers.[40]

So, the laws of nature, even if they turn out to be neo-Platonic, do not have to be in competition with God. Hawking said as much several years after he wrote *A Brief History of Time*. [41]

In Hawking's new reading, the laws of nature can be expressions of God's continuing sustenance of creation. He might even say that in the lawfulness of the cosmos God is present in creation. This doctrine of divine immanence is heuristically useful, I think, towards integration of the NBP and the presence of God in the cosmos.

Divine immanence can also be a guiding hermeneutic in attempts to make sense of the teleological and cosmological arguments for God's existence. Joseph Zycinski rightly points out the following:

> [O]ne should not expect that Hawking's cosmology would provide a new argument for the existence of God the Creator and strengthen the standpoint of Christian theism.[42]

And yet, Hawking's cosmology does have interesting metaphysical implications which, I think, are helpful in reworking the teleological and cosmological arguments.

An icon is a useful concept for what I am suggesting about the teleological and cosmological arguments. In the Orthodox Christian tradition, icons are images (paintings, murals, frescos) that induce the observer to perceive a deeper, supernatural reality[43] beyond the image. I suggest that the teleological and cosmological arguments are also iconic, in that meditation upon them reveals the hidden order of God's immanent presence. I think that this iconic reading is more useful than the traditional way[44] of thinking of them as proofs to convince unbelievers of the existence of God.

In regard to the teleological argument, Sir Edmund Whittaker in his 1946 Donnellan Lectures noted that modern cosmology discloses an intramundane God in the "order, system, adjustment, fitness in the nature of things and in their relations to other things."[45]

> The fact that the laws of mathematics are valid over the entire cosmos, showing that everything is interrelated and consistent, leads to the inference that there is only a single mind involved in the whole creation.[46]

Zycinski makes mention of this same fact, but adds another element to his conclusion.

> [P]hysics itself...never asks why the laws of nature exist when nature itself could have been an uncoordinated disorder in which no regularities could have been determined. Physics presupposes the uniformity of nature, and this presupposition constitutes a *conditio sine qua non* for the existence of physics in its present form.[47]

So, Zycinski and Whittaker see that the essential presupposition of modern science is that the order observed in the world extends throughout the chaos. This assumption of uniform order (which itself can never be explained by science) is undoubtedly a feature built into the human mind. It is a feature that corresponds, one hopes, to a deeper, true order that actually exists in the cosmos. And this cosmic order may itself correspond to a deeper, divine immanence in creation. The jumps from psychology to metaphysics, and from metaphysics to theology in these last two statements are not too large, and seem entirely warranted to me. Meditation on these features of existence—psychological order corresponding to cosmic order corresponding to divine immanent order—unveils the immanent God whose glory the orderly heavens declare.

In regard to the cosmological argument, Zycinski writes:

> [I]n this approach a Clarkean God of edges is replaced by an immanent God sustaining his creation in all moments of time. He remains also transcendent to the created world in the sense that, as the Creator he remains the fount of being for all creation.[48]

There is an important intellectual tradition within Christianity that defines the status of creation in terms of dependence of the created object on its Creator. It was Thomas Aquinas who wrote the following:

> Creation is none other than the relation of the creature to the creator as to the principle of its very being.[49]

This relation remains independent of time; in the Christian intellectual tradition it is described as either *creatio continua* or *creatio passiva*.

So, in an iconic reading of the cosmological argument, this meditation comes to rest upon a God who is constantly upholding the universe with the divine breath. In brief, the teleological argument is transformed from a proof of a deistic watchmaker into an epistemic pointer, a suggestive sign or symbol that exposes, unveils, and reveals the ordering activity of an immanent God. The cosmological argument, instead of being a proof for a cosmic jump-starter, becomes an icon pointing the way to the presence of the immanent God, who constantly upholds, sustains, and makes real a creation that would have no reality apart from God.

A major theme in this paper is the thorough enmeshment of Hawking's NBP with the teleological and ontological arguments for the existence of God. I have shown that Hawking's presentation of the NBP is embedded in evasions of the logic of those arguments. I have also shown that the NBP was motivated by dubious assumptions about the laws of nature and their incompatibility with the existence of God. And yet, however precarious are the philosophical foundations of the NBP, and however wrongheaded its implications for theism, the NBP is an amazing achievement. In the final estimate, the NBP must be praised as a work of creative scientific genius. Also, the NBP can be a source of creative thinking about God's relationship to the universe and a prod for theists to reinterpret adequately the teleological and cosmological arguments, with greater attention to God's immanence. I find that the relationship between the NBP and the existence of God is at least amicable, if not entirely cordial.

Works cited:

Thomas Aquinas. *Summa Theologiae*. Trans. Blackfriars. London: Eyre and Spottiswoode, 1963.

Davies, Paul "Physics and the Mind of God." *First Things* 55 (1995): 31-35.

Hawking, Stephen. *A Brief History of Time*. New York: Bantam Books, 1988.

Peacocke, Arthur. *God and the New Biology*. San Francisco: Harper and Row, 1986.

Ross, Hugh. *The Creator and the Cosmos*. Nashville: Navigators, 1995.

Stoeger, William. "Quantum Cosmology and the Laws of Nature." In *Physics, Philosophy, and Theology*, ed. by J. Leslie, 209-34. New York: Macmillan, 1990.

Worthing, Mark. *God, Creation, and Contemporary Physics*. Minneapolis: Fortress, 1996.

Zycinski, Joseph. "Metaphysics and Epistemology in Stephen Hawking's Theory of the Creation of the Universe." *Zygon* 31: 269-84.

_____. "The Laws of Nature and the Immanence of God in an Evolving Universe." In *The Interplay Between Scientific and Theological Worldviews*, part 1, ed. by Niels H. Gregersen, Ulf Görman, and Christoph Wassermann, 3-19. Geneva: Labor et Fides, 1999.

Endnotes:

1. Hawking, p. x.

2. A singularity is the idea that at the beginning of time, the universe was once a point of infinite density and infinite space-time curvature. A singularity is predicted mathematically by Einstein's theory of General Relativity. However, the idea was unacceptable to most scientists until Hawking and Roger Penrose showed that Black Holes (whose existence can be empirically demonstrated) contain these singularities.

3. Interestingly, quantum mechanics and general relativity have generally been taken

to be contradictory (the former being indeterministic, the latter being deterministic). Hawking predicts that they will be reconciled (perhaps by superstring theory.

4. Ibid., p. 174.

5. Zycinski, "Metaphysics and Epistemology."

6. I refer to the brute fact of order in the cosmos as "cosmic order." This term does not imply any element of theistic involvement. A more theistically laden term for the same phenomenon is "fine-tuning."

7. These four physical constants (and many other similar examples of precisely balanced physical constants) deserve the appellation, "cosmic order." This is because, if they were just the tiniest bit higher or lower, the universe would be either instantly annihilated or intensely uninteresting.

8. Hawking, p. 122.

9. Ibid., p. 125.

10. Hawking takes the SAP to mean that there are many different universes or regions of the universe each with a different initial configuration and set of laws.

11. The universe may be ordered, not because it is fine-tuned, but merely because we happen to be in one of the few universes that allowed for intelligent life. Our amazement at fine-tuning would grow dull if we learned that we live in one universe among many — the one that contains intelligent-life-generating laws.

12. Hawking rejects the SAP on two grounds: the principle of economy cuts out the idea of multiple universes, and the whole tide of the history of science flies in the face of gross anthropocentrism.

13. The inflationary model describes an extremely rapid expansion during the first moments of the universe. According to Hawking, this initial inflation inherently transforms the early chaos of the universe into order.

14. Hawking, p. 126.

15. Ibid., p. 132.

16. Ibid., pp. 132-33

17. Ibid., p. 137

18. Hawking describes his own contribution to the singularity theorem on p. 50: "Penrose's theorem had shown that any collapsing star must end in a singularity; the time-reversed argument showed that any Friedmann-like expanding universe must have begun with a singularity."

19. Ibid., p. 141.

20. Ibid., p. 46.

21. Ross, p. 64.

22. Hawking, p. 122.

23. Ibid.

24. Ibid., p. 123.

25. Ibid., p. 133.

26. Ibid.

27. Ibid., p. 138.

28. Ibid., p. 175.

29. Ibid., p. 11.

30. Ibid., p. 10.

31. Ibid., p. 122.

32. Zycinski, "The Laws of Nature," p. 7.

33. This assignment of a high ontological status to the laws of nature is often known as realism.

34. Hawking, p. 9.

35. Ibid., p. 139.

36. Stoeger.

37. Zycinski, "Metaphysics and Epistemology," p. 270.

38. Zycinski, The Laws of Nature," p. 4.

39. Peacocke, p. 95.

40. Davies, p. 34.

41. In a BBC interview in 1992, Hawking moderated many of his earlier philosophical comments concerning his no-boundary model of creation. Repudiating the naive Clarkean theology, he admitted that the model itself justifies no conclusion regarding the existence or the nonexistence of God. It only illustrates that the possible creative act of God was not arbitrary in nature but depended on laws and principles known to theoretical physics.

41. "In a BBC interview in 1992, Hawking moderated many of his earlier philosophical comments concerning his no-boundary model

of creation. Eliminating the naïve Clarkean theology, he admitted that the model itself justifies no conclusion regarding the existence or the nonexistence of God. It only illustrates that the possible creative act of God was not arbitrary in nature but depended on laws and principles known to theoretical physics" (Zycinski, "Metaphysics and Epistemology," p. 281).

42. "[O]ne should not expect that Hawking's cosmology would provide a new argument for the existence of God the Creator and strengthen the standpoint of Christian theism" (Ibid., p. 283).

43. The function (not the result!) of icons is similar to those three-dimensional images that were in vogue several years ago. One was supposed to gaze with intensity upon a complex pattern of lines for several seconds, and then the real image-behind-the-image was supposed to appear.

44. I hesitate to use to word traditional here. I only mean "traditional" in the sense that contemporary philosophers and theologians often argue that tradition has held that the cosmological and teleological arguments are attempts to prove God's existence. I believe that an iconic reading is more in keeping with the historic intentions of the inventors of these arguments.

45. Quoted in Worthing, p. 38.

46. Ibid., p. 39.

47. Zycinski, op. cit., p. 282.

48. Ibid., p. 283.

49. Aquinas, I a.q. 45. Art. 3.

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Does Nature Have Rights? Ethical Implications in Ecology

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In this essay, the author approaches the question "Does Nature Have Rights?" from an ecofeminist perspective, using Aeschylus' The Eumenides *as emblematic of resignifying woman/nature as non-subject, and working primarily from Val Plumwood's* Feminism and the Mastery of Nature, *with reference to the work of Grosz, Irigary, Lovelock and others. She considers ontologies of nature as "intentional," "living" and as a "being" entitled to rights, and weighs the question of revisiting metaphysics in developing an account of nature that would yield an ethos favorable to the health of planet Earth. This account refers to what Irigaray has called "another parousia of the divine."*

Does a river have the right not to be polluted? Does the tiger have the right not to be made extinct? And if so (or not) are these legal as well as ethical rights? Who decides? What are the sine qua nons that qualify beings for rights, and does Nature need or have them? These questions must be asked because Nature is at an ecological crossroads, and someday, someone is going to court on behalf of a lake or a species, or the whole planet, requiring a redescription of Nature which could qualify it legally and ethically to protection from irreparable harm.

I want to consider how to construct such an ethics by reading Nature and rights through ecofeminism. In this essay I work most intensely out of Val Plumwood's book, *Feminism and the Mastery of Nature*, with reference to writings by Irigaray, Grozs, Gatens, and others. I will also refer to the Gaia Hypothesis as a re-imagining of Nature useful to this project. I stipulate that ecofeminism is an ethics, and I suggest that there is no way to give an account of Nature or rights without metaphysics.

Descriptions of "Nature" are constructed not only for issues of survival, but also out of wonder; and, less laudably, in order "ethically" to facilitate human agendas of exploitation. Therefore we have ontologies of Nature as divine, subject, inspirited; and we have ontologies of Nature as dead matter, mindless, object, mechanical; as intentional, and as not; with and without teleology, with and without self-determination. Each of these descriptions serves a human purpose, each essentializes Nature in such a way as to make it comprehensible and/or manageable, as if there were a "something" called Nature. I do not forget that Nature is not just the matter of the physical universe, but its movement also, its "power" and its habit of continual creativity, evolution. Nature is a system of systems not fully comprehended, neither in its behaviors nor in its—dare I say—nature.

This being said, here are some dictionary definitions of (a) rights and (b) nature. The compact edition of the *Oxford English Dictionary* says the following:

> [rights:] That which is consonant with equity or the light of nature; that which is morally just or due; The title or claim to something properly possessed by one or more persons; That which justly accrues or falls to anyone; what one may properly claim; one's due. In accordance with justice or righteousness; righteously in harmony with the moral standard of actions.

> [nature:] The creative and regulative physical power which is conceived of as operating in the material world and as the immediate cause of all phenomena; more or less definitely personified as a female being; the or a state of nature - a) the moral state natural to man, as opposed to a state of grace b) the condition of man before the foundation of organized society; the essential qualities or properties of a thing; the inherent and inseparable combination of properties essentially pertaining to anything and giving it its fundamental character.

The Collins Universal Dictionary gives the following definition of "nature":

> [nature:] the world, the universe, known and unknown; the power underlying all phenomena in the material world; the innate or essential qualities of a thing; the environment of man.

In instances in which Nature is personified in contemporary usage, it is always as female, mother. The ancient Greeks used the same convention. So, a good place to begin is where woman and Nature are "officially" and publicly stripped of personhood, and rights.

The language in these definitions presupposes an anthropocentric, even biblical, worldview. Yet it presumes also an older layer of belief in a creative, organizing power *inherent in Nature itself*, recognizing that this power is always personified as female, and it is to this older layer that we shall appeal for re-imagining Nature, as well as to science. Nature is described here as the "moral state of man [*sic*]" but it also draws a distinction between "man" and nature, between the natural world and the world of God ("as opposed to a state of grace," for instance; no reading here of natural grace). Lastly, "the environment of man" (not other species) positions Nature as a site of concern to humans, even though language of ownership is used.

With regard to rights, Nature plays an ethical role: "that which is consonant with equity or the light of nature," as though equity exists "with...the light of nature." So, in a sense, rights (and ethics) are inherent in Nature itself. And while equity is not quite equality, or sameness, it is described as a characteristic of Nature. The issue of "difference" plays a major role in the construction of ethics for ecofeminists, for example, but "difference" without hierarchy, without domination.[1] Can this be called natural equity? Is Nature the source of ethics? of justice? of rights, including its own?

While much has been made, in criticism on ecological issues, of the biblical account of creation and its God/nature relationship (and with justification), not enough has been said of the role of Greek thought in Western discourse about Nature, and its *negative* effect on the relationship between human beings and the rest of the natural world. Plumwood identifies "the Greek" as a wellspring for the Western ecological dilemma:

> The society of classical Greece is often viewed benignly, by both liberal and environmental writers, as the cradle of western civilization, and the philosophy of Plato is especially revered as the source of its proud intellectual, artistic and civic traditions. [...] [But some feminists] have seen in the Platonic account of reason a masculine identity which has profoundly influenced its character.[2]

She points out that many environmental writers look to the Greeks as "respecting and celebrating the earth through the worship of Gaia" [3] (and this may have been true on a "country" level); but as she demonstrates, even the Gaia story in the hands of Plato is "designed to promote...not environmentalism but militarism."[4] This is because for Plato, as for other Greek writers of the classical period, the focus of ethics and myth is not Gaia as Nature, but *polis* as Nature. So, it is perhaps with some irony that Gaia is offered by Lovelock and Margulis as a scientific model for environmentalism.

I argue that, yes, Nature is a being with rights that were systematically stripped away by resignifying Nature, from living being, to woman, to slave, to mechanism; as object, non-agentive, non-living, as non-*logos*.[5] Before the supremacy of *polis*, Nature was imagined and experienced as an intelligent, creative, giving deity. According to Lovelock, "The idea that the Earth is alive is probably as old as humankind."[6] Undoubtedly. Even today, this belief persists, in other cultures: not only in animist traditions, but also in Hinduism, Buddhism, Jainism, Taoism, some of the "great world religions." How, then, (and why) in the West did Nature become a slave, an object, a non-living mechanism without identity or rights? a "not us"?

According to the dictionary definitions, in instances in which Nature is personified in contemporary usage, it is always as female, mother. The ancient Greeks used the same convention. So, a good place to begin is where woman and Nature are "officially" and publicly stripped of personhood, and rights. I offer as signifier excerpts from the play, *The Eumenides*, by Aeschylus. *The Eumenides* (meaning, more or less, "nice old ladies") is the third play of a trilogy on the Trojan War, the *Oresteia*. It marks a point not only at which female genealogy is suppressed,[7] but more significantly for this study, a point at which "mother" ceases to have rights—and furthermore, ceases to be.

This Greek "soap opera" tells the story of how Orestes, son of Agamemnon, kills his mother because she killed his father because he sacrificed their daughter Iphegeneia for a fair wind to Troy. The ghost of Clytemnestra, the murdered mother, rouses the Furies, the ancient retributive arm of the old Earth Goddess, to bring him to justice. (Notice that justice was assumed to arise from Earth.) Apollo, who admits to having incited Orestes to kill his mother, argues for Orestes in court:

> The mother, so-called, is not the child's
> begetter, but only nurse of the new-sown
> embryo; the one who mounts, the male,
> engenders, whereas she, unrelated,
> merely preserves the shoot
> for one unrelated to her.[8]

The language used here clearly inscribes woman as a passive field, Earth, and like the field as not related to the "shoot" growing in her. As proof, he offers the Goddess Athena (born *unnaturally*, full-grown from Zeus' forehead):

> [A] father could give birth without a
> mother; near to hand
> there is one who was not nurtured in a
> womb of darkness
> but is the kind of shoot that no goddess
> could give birth to.[9]

In this short speech Aeschylus/Apollo reduces woman to body/field/nature and strips away her rights as mother, indeed, strips away the word and meaning "mother"—that is, the source of life, relatedness. By disconnecting child from mother they/he disconnect(s) human from Nature. The Furies are argued out of supporting mother-right by a soothing speech from Athena, who is made by Aeschylus to repudiate her own mother (Metis, swallowed by Zeus, out of fear of the child she was carrying), and to announce:

> [T]here is no mother who gave birth to
> me
> and I approve the male principle in all
> things and with all my heart.[10]

Athena casts her vote such that Orestes is acquitted of matricide, because he had no mother to murder in the first place. It is not accidental that Athena is goddess of war and is identified with *polis*, not wild "female" nature. She is herself stripped of her femaleness (and her older, chthonic identity, identifiable by her familiars, the snake and the owl) to act as poster girl for the glories of patriarchy. *Polis* triumphs.

The shift in this text from mother-right to full-blown patriarchy provides a "rational" ethos for domination—male over female, Greek over barbarian, master over slave, human over Nature. It sets up dualisms that Plumwood argues are at the heart of the "master model," and provide ethical and legal justifications for war, slavery, and colonialisms. It "unpersons" woman and Nature simultaneously, and disempowers both, by redefining their ontologies. It is only a short hop from the not-us-ness of women to the not-us-ness of other beings who may be wanted for slave labor, including the Earth itself. "Mother" and "Nature" can no longer legitimately defend themselves, even if they still had their rights, because their retributive arm, the Furies, has been neutralized. It is evident in this account that the rape and plunder of Nature is no sin, since Nature has no more rights and is no more a "person" than the human female is. Not "us." Not eligible for "rights." (Ironically, this structure mirrors Athenian "democracy" exactly.)

The legacy of estrangement from Nature must be dealt with, a system of dualisms inherited from the Greeks and Hebrews by which human beings exclude each other, different species, and the planet itself.

These few lines by Aeschylus show the movement from one ethos to another. The rejection of the "womb of darkness" is exactly a distancing of the human from identification with body and Nature, and from the ethos of the natural world—just as the Delphic Oracle's original source of knowledge and ethics (Gaia) is replaced by violent inhabitation by Apollo: he literally murders the old order (Pythoness) and rides the Oracle like a rapist.[11] Here the voice of Nature (Gaia) is displaced by an ethos/ deity who anoints himself with the "right" to speak through violence. Might makes right(s). Thus, Earth/woman, who was a speaking subject is silenced, objectified, becoming a vessel through which the male voice passes (witness the bizarre speech of Athena). By male gods' appropriating such powers over the female, "'Mother Nature' is depotentiated, and her birthgiving powers are taken over by the male."[12] And depotentiating Nature rationalizes (provides a divinely sanctioned ethos for) the wanton destruction of Nature that many are even now scrambling to undo. Aeschylus' unmothering here is heard all the way down to Freud's strange (or not) belief that the human (male) is forever trying to repudiate, distance himself from, and simultaneously appropriate the mother (Nature).

Aeschylus' text opens two areas for discussion: (1) the simultaneous description of woman and Nature as identical (and as collectively "other"), making way for the construction of the patriarchal ethos as "right," "justified," divinely sanctioned; and (2) the revelation that everything from ontologies to ethics can be (and is) constructed, and as such can be de- and reconstructed. Most important here is the violent (and unnatural) construction of an ethos of patriarchy on the broken backs and confiscated rights and subjectivity of both women and the natural world. While Eisler uses the term "dominator model" to refer to the patriarchal ethos, Plumwood prefers the term "master model." Either will do, though Plumwood's term, "master" is more evocative in relational terms.

I have stipulated that I read ecofeminism as an ethics: it argues from a positive ethical position that gender (and every other) equality is "right" and naturally right, and that all forms of inequality and domination are "wrong." By this yardstick, every exercise of power-over that disadvantages the dominated is morally wrong. For the dominated to be disadvantaged, it has to be in such a state of being as to experience disadvantage—that is, alive and feeling—and that in order for the disadvantaging to be justified, the donimated has first to be reinscribed as an object (woman, Nature), an "other" that does not inherently have the same "nature" nor essence of "subject" as the exerciser of power-over, the dominator, the master.

I identify planet Earth as the primary locus of this discussion of Nature, because the immediate ethical problem of our relationship with Nature is with our own planet. Aeschylus notwithstanding, Earth is indeed our mother: it gave birth to us in whatever way a planet gives birth to its biota. This being said, how is it that we pay scientific lip service to this verity yet, at the same time, imagine ourselves ontologically as "other"? Or more properly, how is it that we imagine the planet as "other" (than us)? Greek and biblical accounts identify the source of human life (and that strange factor, mind) as sky father gods who absurdly try to give birth or create without matter/mother being anything beyond instrumental to the father. In the Greek account, Nature/woman is stripped of rights. In the biblical account, Nature has no rights to begin with. It is the property (like a wife, perhaps) of God. Both accounts are violent. This is the official legacy of Western thought.

There is, of course, that unofficial legacy, what Irigaray calls "a sedimentation laid down in its time by earlier traditions."[13] She is referring to older beliefs of the inspiritedness of the natural world. Irigaray goes so far as to suggest that the death of the phallic god heralded by Nietszche is "not about the disappearance of the gods but about the approach or the annunciation of another parousia of the divine."[14] An optimistic thought: perhaps this is Lovelock and Margulis' Gaia. This old "sedimentation" is the shadow tradition of Western thinking, appearing as Francis of Assisi, Hildegarde, Keats, Thoreau, Spinoza, marginalized thinkers: poets, mystics, and heretics. Yet this "sedimentation" is a persistent source for the reconstruction of the rights of Nature.[15]

But now the legacy of estrangement from Nature must be dealt with, a system of dualisms inherited from the Greeks and Hebrews by which human beings exclude each other, different species, and the planet itself. Plumwood describes this system as "hyperseparation"[16]; all of these "others" have been forcibly inscribed as discontinuous from each other. Plumwood argues:

> [Nature itself] in most of its senses and contrasts is subject to *radical exclusion* and is conceptually constituted by it, as well as by the other features of dualism. [...] There is a total break or discontinuity between humans and nature, such that humans are completely different from everything else in nature.[17]

Different and *superior*, that is, masters of one or another ontology of Nature that leaves it in the "slave" category.

> Although the relationship (between master and slave) is usually...presented as being in the interests of the dominated as well as the dominator, it is apparent that those on the lower side of the dualisms are obliged to put aside their own interests for those of the master or centre, that they are conceived of as his instruments, as a means to his ends.[18]

That Nature has been "ontologized" as a means to human ends is not news, nor is it news that the Western view of Nature does indeed categorize it as slave. But it is a disobedient slave, like woman; and without benefit of phallic rule, it is characterized as "lacking", just as the Lacanian/Freudian/Aristotelian woman is lacking (penis = mind/soul). Plumwood writes:

> That women's inclusion in the sphere of nature has been a major tool in their oppression emerges clearly from a glance at traditional sources: "Woman is a violent and uncontrolled animal" (Cato); "A woman is but an animal and an animal not of the highest order" (Burke); "I cannot conceive of you to be human creatures, but a sort of species hardly a degree above a monkey" (Swift); [...] "A necessary object, woman, who is needed to preserve the species or to provide food and drink" (Aquinas).[19]

I repeat these quotations as a reminder that the contiguity of woman and Nature is continuous throughout patriarchal history. The disdain for natural and, in particular, animal life evident in these statements prevents Nature, animal, woman, from entering the sphere of "us," the ethical, those who deserve rights. It is little wonder, then, that there is such difficulty in knowing how to address the rights of Nature, when the rights of women and other "others" (races, species, etc.) have only begun to be addressed.

One approach some feminist writers[20] have taken is to reimagine the term "difference," (since hierarchies of oppression are always predicated on difference in phallic culture) and the term "other." Difference, they argue, is not a matter of hierarchy but of "nature." Plumwood suggests "a notion of otherness as *non-hierarchical difference*. The resulting concept of relevant otherness avoids exclusion" [21]—the kind of exclusion that inferiorizes the "other."

> [But] recognition of and respect for the intrinsic value of the other is an essential adjunct to an ethic of care and respect for difference...to the extent that respect is directed to the other for its own sake, it will not be respect just for those aspects of the other in which it resembles us, and hence will entail respect for difference.[22]

She also offers a reading of "other" as inclusive, or rather as "included," but this reading does not reject difference: she identifies other species, and individuals of other species, as "earth others":

> We can relate to earth others as conceived in the intentional stance in terms of mutual exchange and transformation, and "the dance of interaction." [23]

Her attempt here is to construct a relational model which recognizes difference without hierarchy, without speciesism. The term "intentional" which she uses to refer to the "earth other" is deliberately chosen to propose an equality of aliveness of other species, not only among themselves, but in relation to the human species.

> A view of self as self-in-relationship can not only explain how instrumentalism can be avoided but also provide an appropriate foundation for an account of the ecological self, the self in non-instrumental relationship to nature [such that the] ecological self can be viewed as a type of relational self, which includes the goal of the flourishing of earth others and the earth community among its own primary ends, and hence respects or cares for these others for their own sake.[24]

A series of interrelated subjectivities emerges as part of Plumwood's account of the natural world, that "dance of interaction."

Her term "non-instrumentalism" is key to her development of ethics, and in this text she wishes to evolve a whole ethics out of a critique of domination as it affects all designated "others" in the patriarchal sense: gender, race, class, species etc. Thus, the model of the "other" as instrumental (to whoever is the dominator) must be eliminated. She defines instrumentalism:

> ...a mode of use which does not respect the other's independence or fullness of being, or acknowledge their agency. It recognises no residue of autonomy in the instrumentalised other, and strives to deny or negate that other as a limit on the self and as a centre of resistance.[25]

The key words are: independence, agency, autonomy, limit, resistance. These terms, along with intentionality, are indicators toward Plumwood's restructured ontology of the whole of the natural world, human beings included.

> [T]he ecological self recognises the earth other as a centre of agency or intentionality having its origin and place like mine in the community of the earth, but as a different centre of agency, which limits mine.[26]

So, her ethics recognizes common origins for all, but differences in "agency," and that "making room" for the "earth other" as equal means I must recognize and accept limits to my own agency. This she names "mutuality," which calls for the "recognition of and respect for the intrinsic value of the other...[as] essential adjunct to an ethic of care and respect for difference." [27]

And also *sameness*. Plumwood rather bravely suggests re-assigning to Nature, and to "earth others," such "mind" qualities as intentionality, emotion, agency and teleology:

> The unfolding, development and directness inherent in natural processes also involve a kind of teleology and intentionality....[28]

Nature as goal-oriented! This comes very close to a construction of Nature as alive and thinking, a "subject." For the present purposes, to determine if Nature has rights, Plumwood offers arguments that lead straight to the point. She urges that "earth others" be seen as "other nations," as some Native cultures do; and such an account of other beings as "same" with some differences is close to what Plumwood is looking for.

She builds up the bones of an ethics of natural rights for all beings, but does not go so far as to develop fully a "being" for Nature itself; rather, she describes a web, a relationalism among beings that constitutes a sort of whole, which we might call Nature. Its nature is collective, and I believe that she, like many other thinkers, is still not free of the dualism of the One and the Many—that is, she has not recognized that they are not mutually exclusive. For Plumwood, Nature is as a kind of living, intentional, teleological, self-determining, and feeling collective of related beings, having the earth, and being a part of it. This is a kind of "whole," though she is very careful not to homogenize and obliterate individuality and difference.

Feminist thinkers are, of course, not the only ones to have attempted an account of Nature that could be eligible for "rights." I have mentioned the Gaia Hypothesis, which comes not from philosophy, but from science. It proposes that the Earth is a living, self-regulating organism. As an originator of the concept, James Lovelock writes, "The idea that the Earth is alive is at the outer bounds of scientific credibility." [29]

Nature as goal-oriented! This comes very close to a construction of Nature as alive and thinking, a "subject."

But this proposal is not new—which is why it was named Gaia—and not new in science, as Lovelock tells it. In 1785, Scottish scientist James Hutton proposed to the Royal Society of Edinburgh "that the Earth was a superorganism and that its proper study should be physiology." [30] A living body, if not one with a mind, as a superorganism it is at least in some way organized. Lewin explains:

> [A superorganism] can be thought of as a group of individual organisms whose collective behaviour leads to group-level functions that resemble the behaviour of a single organism.[31]

This theory recognizes *co-operation* as being equally important as the *competitive* struggle of the individual organism for existence, and is similar to Gaia. Lovelock is clear about the ethical implications of Gaia:

> In Gaia we are just another species, neither the owners nor the stewards of this planet. Our future depends much more upon a right relationship with Gaia than with the never-ending drama of human interest.[32]

And what is a "right relationship" with Gaia? How do one behave toward a goddess? Eliot Deutsch argues that "natural reverence" is essential to the development of ethical behavior toward the planet, toward Nature:

> Without what I am calling "natural reverence" I don't see how it is possible for us to do more than work out temporary, makeshift adjustments in our actual working relations with our natural environment.[33]

He argues for a "metaphysical grounding" [34] for the development of "natural reverence," and I am hard pressed to see how it could be done otherwise. A shift in metaphysics seems unavoidable, and Deutsch suggests borrowing from Eastern sources. I will not disagree with this suggestion, but will also not pursue this avenue here, in the interests of brevity. But on the important point of metaphysics, accounts such as Plumwood's already present a nascent metaphysics of Nature on which to build. Callicott also describes a kind of "relational" self as vital to a metaphysics of Ecology.[35] While much postmodern criticism wants to do away with metaphysics (its habit of essentializing, etc.), these scholars seem to assume that metaphysics is a tool, not an end in itself, one that is mutable, and shifting, much like the movement of natural energies:

> In the "organic" concept of nature implied by the New Ecology, as in that implied by the New Physics, energy seems to be a more fundamental and primitive reality than material objects. [...] An individual organism, like an elementary particle is, as it were, a momentary configuration, a local perturbation, in an energy flux or "field" [so that it] is impossible to conceive of organisms...apart from the field, the matrix of which they are modes.[36]

This holistic account of nature squares with Gaia, with superorganism, and with Plumwood's community of interdependent dancing "earth others."[37] Like Plumwood's model, it recognizes difference and individuality without privileging them. Callicott also calls for the abolition of the human ego and espouses a metaphysics of continuity between human beings and the rest of the natural world, emphasizing the interrelatedness of the entirety of Nature at a pre-organic level, presenting a picture of Nature as Matrix, Mother. And at that fundamental level, questions of *essential* difference are obliterated by an account of differences as "momentary configuration[s]...in an energy flux or 'field.'" That is, the shift of emphasis is away from "solid matter" to the behavior of energy. This model does not directly accord consciousness to the Matrix, but certainly creativity; and among Nature's creations are human and other forms of consciousness, so consciousness can be said to be a characteristic of Nature. Intentionality can be said to be a characteristic of consciousness, so it follows that intentionality is a characteristic of Nature, as Plumwood has suggested. By inference, then, intentionality can be drawn from the Matrix model. Whether this Matrix can be said to possess an intentionality of its own is perhaps not possible, though Plumwood has argued for this conclusion regarding Nature, as I have shown. And if Nature possesses consciousness, feeling, and intentionality (and by extrapolation teleology) can it be called a person? Does it have a subjectivity? And if it is a subject, is it eligible for rights, and is it eligible for justice if it is being harmed?

The writers cited above would clearly like to construct a metaphysics of Nature that would account for the rights Nature gives its members: the right of all beings not to be dominated by others, but to live in respectful relation with each other. Irigaray suggests that ethics begins in wonder.[38] McCance counsels searching among the marginalized, the excluded, for sites for the development of ethics.[39] Likewise, Plumwood begins with the excluded (women, other races, other species) and opens her ethics to all.

So does Nature have rights? Plumwood's account of Nature as intentional, agentive, teleological, and intersubjective (if not outright subject) suggests that yes, Nature is being, if not *a* being; Lovelock and Margulis argue that Earth (if not Nature as a whole) is a living being. Does Earth so-described have rights? And if so, what rights could it have? What rights does it need? Will human beings afford respect only to those beings that have been accorded rights? Historically, "rights" have descended stepwise from self-privileging upper-class males, to males of other classes, to females, to persons of other races, to animals—and now, finally, to Nature itself,[40] as each of these marginalized categories is recategorized: so, "female" is accorded personhood and gets to vote; "other race" is recategorized as equally human; "animal" is recategorized as living being with feelings, and so on. In each case, the "nature" of the "being" is redefined. If Nature can be described as a being, it should be eligible for legal rights, somewhere along the line. But if it is a "god" (Gaia), does it need rights?

Because accounts of Nature (including scientific accounts) are so diverse, and because metaphysics is out of fashion (not to mention a little bit dangerous), it is very difficult to call for the rights of a Nature that is a "being-in-itself" that would "qualify" for rights. Yet one wants to. One wants to apply justice to the despoilers of the planet, to be Nature's advocate in court. Something almost instinctual says that trashing Nature is unethical, as even Aeschylus surely knew that abolishing mother-right was wrong: it had to be done violently, and by arguing a rationalized, false biology (women are not related to their children), and a revised metaphysics of Nature that characterized it as instrument, rather than as agentive being.

Oppressed groups have given an account of what it is like to be oppressed. It is these accounts of oppression that are altering attitudes and behavior toward other human beings and toward animals. How does Nature as a whole give an account of the effects of human exploitation? If we understand the Earth as a superorganism, can we deduce its suffering, as we would deduce suffering from, say, a flatworm? a colony of bees? What methods can we use to "hear" the voice of the Being, Nature? The "evidence of Nature" is invariably always already mediated by human discourses, be they economic, scientific, or theological.

While ecological devastation is by no means confined to the West, it has, as Deutsch has suggested, its metaphysical and ethical origins in the West. These origins are inscribed *in* and *by* the dualisms and "otherings" of Western patriarchal myths, theologies, philosophies, sciences, and agendas of greed, conquest, and colonization. These agendas have constructed ontologies of the natural world that justify the instrumentalization of Nature, along with all designated "others." Other cultures offer models of the natural world suitable to the development of environmental ethics, but the West is distanced by time from its own such models. However, it does possess the discursive tools needed to revisit and revise them in order to undo the collective internalization of what I call faulty values, and to prevent further export and exercise of these "values."[41]

Works cited:

Aeschylus. *Eumenides.* Trans. Anthony J. Podlecki. Warminster, England: Aris and Phillips, 1989.

Baring, Anne, and Jules Cashford. *The Myth of the Goddess: Evolution of an Image.* London: Arkana, Penguin Books, 1987.

Callicott, J. Baird. "The Metaphysical Implications of Ecology." In *Nature in Asian Traditions of Thought: Essays in Environmental Philosophy*, ed. by J. Baird Callicott and Roger T. Ames, 51-64. Albany: SUNY Press, 1989.

Collins Universal Dictionary. London: William Collins & Sons, 1973.

Deutsch, Eliot. "A Metaphysical Grounding for Natural Reverence: East-West." In *Nature in Asian Traditions of Thought: Essays in Environmental Philosophy*, ed. by J. Baird Callicott and Roger T. Ames, 259-65. Albany: SUNY Press, 1989.

Eisler, Riane. *The Chalice and the Blade: Our History, Our Future.* Pacific Grove, Cal.: HarperSanFrancisco, 1987.

Gatens, Moira. *Imaginary Bodies: Ethics, Power and Corporeality.* London: Routledge, 1996.

Goodrich, Norma Lorre. *Priestesses.* New York: HarperPerennial, 1990.

Grosz, Elizabeth. *Space, Time and Perversion: Essays on the Politics of Bodies.* New York: Routledge, 1995.

_____. *Volatile Bodies: Toward a Corporeal Feminism.* Bloomington, Ind.: Indiana University Press, 1994.

Irigaray, Luce. *An Ethics of Sexual Difference.* Trans. Carolyn Burke and Gillian C. Gill. Ithaca, N.Y.: Cornell University Press, 1993.

Le Doeuff, Michele. *Hipparchia's Choice: An Essay Concerning Women, Philosophy, Etc.* Trans. Trista Selous. Oxford: Basil Blackwell, 1991.

Lewin, Roger. "All for One, One for All." *New Scientist* 152 (Dec. 1996): 26-33.

Lovelock, James. *The Ages of Gaia: A Biography of Our Living Earth.* New York: W. W. Norton, 1988.

McCance, Dawne. *Posts: Re Addressing the Ethical.* Albany: SUNY Press, 1996.

Nash, Roderick Frazier. *The Rights of Nature: A History of Environmental Ethics.* Madison: University of Wisconsin Press, 1989.

Oxford English Dictionary. Compact Ed. Oxford: Oxford University Press, 1971.

Plumwood, Val. *Feminism and the Mastery of Nature.* London: Routledge, 1993.

Endnotes:

1. Plumwood.
2. Ibid., p. 72.
3. Ibid., p. 73.
4. Ibid.
5. Ibid., p. 78.
6. Lovelock, p. 10.
7. Irigaray.
8. Aeschylus, p. 103.
9. Quoted in Podlecki, p. 103.
10. Ibid., p. 109.
11. Goodrich.
12. Baring and Cashford, p. 335.
13. Irigaray, p. 115.
14. Irigaray, p. 140.
15. Nash; Plumwood; Gatens; Lovelock.
16. Plumwood, p. 49, passim.
17. Ibid., p. 70.
18. Ibid., p. 53.
19. Ibid., p. 19. Plumwood is quoting from Cato (1989), p. 193; Burke (1989), p. 187; and Aquinas (1989), p. 183.
20. Plumwood; Irigary; Grozs, *Volatile Bodies* and *Space, Time and Perversion.*
21. Plumwood, p. 58.
22. Ibid., p. 160.
23. Ibid., p. 156.
24. Ibid., p. 154.
25. Ibid., p. 142.
26. Ibid., p. 159.
27. Ibid., p. 160.
28. Ibid., p. 135.
29. Lovelock, p. 3.
30. Lovelock, p. 10.
31. Lewin, p. 28.
32. Lovelock, p. 14.
33. Deutsch, p. 259.
34. Ibid.
35. Callicott, p. 63.
36. Callicott, p. 59.
37. See n. 22, above.
38. Irigaray.
39. McCance.
40. Nash.
41. Either that, or Gaia will bring back the Furies Herself. And they will not be nice old ladies.

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On Sculpting Ivory: The Idea of Nature in a Theology of Culture

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In this essay, the author seeks to understand the way in which a theology of culture can develop an understanding of nature. He begins by giving a definition for a theology of culture, using the work of Paul Tillich. It is in defining, next, what is meant by nature that many of the peculiarities and problems within this subject are discovered. Finally, it is only by looking at the notion of historicality that he finds the answer to the question.

The story of Pygmalion and Galatea deserves close examination by theology, for it brings to light many questions of theological import. One quotation in Ovid's telling of the story might pique interest:

> [W]ith wondrous art he successfully carves a figure out of snowy ivory, giving it a beauty more perfect than that of any woman ever born.... Often he lifts his hands to the work to try whether it be flesh or ivory; nor does he yet confess it to be ivory.[1]

Pygmalion, in his sculpting, beckons us to ask how we can understand the relation between nature and culture, between that which is humanly manufactured and that which is conceived without fabrication by human hands. And so, in light of Pygmalion and his love, we ask: What can a theology of culture tell us about nature?

In developing an answer, my argument will proceed in five steps. The first step is providing a brief definition of a theology of culture, based on Paul Tillich's work. Next, a definition of nature, as it is understood by theology, will be discussed. However, an unambiguous definition of nature cannot be given; instead, I must recognize that nature is understood through two contradictory definitions. The third step of the argument will examine part of the foundation of these two definitions. Both definitions of nature are structured around two tensions found in the conception of nature. It is only through recognizing the underlying cause of these tensions that one can understand what is meant by the ambiguous concept of nature. The basis of these tensions therefore allows the place of nature in a theology of culture to be recognized. The fourth step of this argument is to explicate such a basis in the concept of historicality, using Gordon Kaufman's understanding of biohistoricality and the description of history as both event and narrative. The final step of this argument, closely tied to the fourth, will show that human persons are simultaneously historical and natural beings—but that nature, too, is historical and biological. Therefore, a theology of culture must negotiate an understanding of nature in light of two different dimensions of history: (1) nature as nonparticipatory in the transcendence of the dimension of narrative, and (2) nature as participatory in the historicality of event. Through this argument, I will show that nature and humanity share certain dimensions of historicality, while other dimensions of historicality allow a transcendence of humanity over nature. Since history provides the foundation for culture, a theology of culture can understand nature by recognizing that culture and nature share a common historicality (as event), while humanity finds its transcendence from nature through historicality (as narrative).

A theology of culture

The starting point is a brief definition of a "theology of culture." Paul Tillich begins his essay, "On the Idea of a Theology of Culture," by describing the relationships between various disciplines in light of cultural analysis. With this beginning, Tillich wishes to acknowledge a possible starting point to aid in understanding what is meant by a theology of culture. Here, Tillich's interpretation of the difference between the study of culture and the natural sciences is found: contrary to the natural sciences, the cultural sciences are based on the fact that "the standpoint of the systematic thinker belongs to the heart of the matter itself."[2] There are no strictly universal concepts within the study of culture—these universals (if not useless) are simply hidden or disguised normative concepts with some form of concrete basis in reality.

Our experience of nature must be based on categories and concepts that we place upon it, such that nature becomes raw material (or "standing-reserve" in Heidegger's words) or a completely mysterious, devotional Other.

Thus, one is directed by Tillich to a very specific definition of a theology of culture: a "religious interpretation of the autonomous culture and its development" that is based on "the presupposition...that in every cultural creation...an ultimate concern is expressed, and that it is possible to recognize the unconscious theological character of it."[3] Another way to explain the idea of a theology of culture, in Tillich's terms at least, is to recognize that culture must be viewed in light of religion as "ultimate concern." He writes:

> Religion as ultimate concern is the meaning-giving substance of culture, and culture is the totality of forms in which the basic concern of religion expresses itself. In abbreviation: religion is the substance of culture, culture is the form of religion.

A theology of culture, recognizing that theology has no domain solely for itself, is the task of finding the "depth dimension" within the human sphere.

From the standpoint of this definition—and recognizing that it holds certain limitations—what is the relationship between a theology of culture and "nature"? Tillich, in "On the Idea of a Theology of Culture," says:

> At this point now the question could be raised why the whole of the work [of a theology of culture] is limited to the analysis of culture and why nature (or technology) is excluded. The answer is that for us nature can only become an object through the medium of culture, if at all.... The essence of nature is quite out of our reach, and we cannot even comprehend it sufficiently to be able to speak positively of such an essence. But as nature only becomes a reality to us through culture, we are justified in speaking exclusively of "cultural theology" and in rejecting a concept such as "natural theology." Any religious substance or import that may exist in nature lies in the cultural functions insofar as these are related to nature.[4]

Though it might seem from this quotation that nature (as an object of study, at least) is possibly beyond the reach of a theology of culture, Langdon Gilkey's work, *Nature, Re-*

ality, and the Sacred, shows that a theology of culture can be utilized to look at the relationship between nature, science, and theology. For the present purposes, it is important to note that nature has a role in theology because, among other things, nature is part of the structure of culture:

> Thus all of culture—art, myth, morals, politics, practical crafts, and even science, all of the facets of spirit and reason—stretches back into the dimness and mystery of matter, of nature as our source and ground.[5]

The following discussion attempts to take seriously the insights of Tillich and Gilkey, by exploring the place of nature in a theology of culture—in other words, by exploring the relations that make possible a discovery of a sense of the divine in nature, taking religion as Tillich saw it: "Religion is not a special function of man's spiritual life, but it is the dimension of depth in all of its functions."[6]

On the very concept of nature

While defining a theology of culture might seem relatively straightforward, finding a suitable definition of nature is not. In fact, the very concept of nature is embedded within a paradox, as Ezarim Kohák points out in terms of an understanding of the human ecological place:

> Humans cannot be both the species that sets the rules for the world (anthropocentrism)—and at the same time just one species among many within that world (ecocentrism).[7]

It must be conceded that there is always an ambiguity in a concept of nature, because in the our relationship to nature we are unable to ascertain the being of nature qua nature. Our experience of nature can never be of a sort that relates strictly to an essence of nature, since we can experience nature—however we define it—only through cognitive and cultural schema. Theologically and philosophically, the result of this ambiguity is that we have not one operative definition of nature, but two. These two definitions are somewhat contradictory, but both are used in our conception of nature.

The first definition stems from what Kohák identifies as the anthropocentric: it is the definition of nature as separated, independent, and Other. It is nature as that which is not part of the cultural and societal world of the human person. Kohák reveals the implications of this definition when suggesting three ways of experiencing nature in this light: "as an awesome presence to be placated and worshipped, as a working partner to be understood and respected, and as a raw material to be used and exploited."[8] In each of these, the human person is seen as separated from nature, while able to manipulate or otherwise relate to it as an object of perception. This manipulation shows how nature as Other, as against the human cultural sphere, must be taken into the cultural. Ultimately, nature is subverted into a sameness with the cultural. This objectification of nature has scientific, philosophical, and religious consequences. Harold Oliver comments that, since the Enlightenment, the concept of nature has been under the "custody" of Newtonian science as a mechanistic and deterministic object, "bereft of its vitality and value." In light of this, Oliver continues, the view of nature by theologians also hardened:

> Theologians were made increasingly aware that many religions of the world stressed harmony with nature, but could discount this as paganism, just as they rejected Romanticism's flirtation with nature as an excrescence of paganism.[9]

Nature, as understood through this first definition, contains an aspect that has no positive definition; instead, it is defined as that which is not culture—the raw, untreated and unmediated object, which is found prior to its human transformation into artifact or tool. Joyce Carol Oates expresses this definition of nature—and the paradoxical need to explain this facet of nature as the Other through cultural means—in the essay, "Against Nature":

> It has no sense of humor: in its beauty, as in its ugliness, or its neutrality, there is no laughter. It lacks a moral purpose. It lacks a satiric dimension, registers no irony. Its pleasures lack

> resonance, being accidental; its horrors, even when premeditated, are equally perfunctory, "red in tooth and claw" et cetera. It lacks a symbolic subtext—excepting that provided by man. It has no (verbal) language. It has no interest in ours. It inspires a painfully limited set of responses in "nature-writers"—REVERENCE, AWE, PIETY, MYSTICAL ONENESS. It eludes us even as it prepares to swallow us up, books and all.[10]

This side of nature, insofar as we confront it as a radical Otherness that is apart from the cultural framework of the human, is experienced only after it is mediated through a cultural transformation into "our image"—our image as builders, producers, etc. In other words, our inability to see this Other as itself comes from our separateness and estrangement from it; our experience of it must be based on categories and concepts that we place upon it, such that nature becomes raw material (or "standing-reserve" in Heidegger's words) or a completely mysterious, devotional Other. In either case, nature is to be used as material for cultural upbuilding. At the same time, nature as Other is not only that material which we use for the upbuilding of culture—it is also what reminds us that we are alienated and separated from nature by virtue of the very same upbuilding.

But I have shown only one side of nature. A second definition, as equally valid as the first, assumes that nature is the totality of all objects and processes—in other words, it is a regulative idea similar to Kant's understanding of world, as Gordon Kaufman suggests.[11] This second definition resonates with what Kohák identifies as the ecocentric. Perhaps the most important aspect of this definition is this: because nature is a totality, there is no differentiation between the natural and the non-natural. According to this definition of nature, nothing can be classified in the latter category; nature, in this sense, is the sum total of every process and object. Nature, in this second sense, is in many respects contrary to the nature portrayed by the first definition. By the second definition, nature cannot be Other, nor can it be simply raw material, nor is it separated from the human cultural sphere. In sum, another side of nature is present, insofar as we are participants in the processes of nature, i.e., in the totality of the world. Through being, we share a degree of relation to all other beings; therefore, we need not mediate our relation to other objects through cultural manipulation and transformation of otherness, so long as we all participate in the common structure of nature.[12]

As stated above, both definitions are used in an overall conception of nature, though the two are contradictory in some respects. Just as the first definition presents the human as separated from the world, the second definition presents the human as part of nature, finding the human world continuous with the natural. While the first definition presents the cultural structures of humanity as using the natural for raw material, the second definition points out that, in some sense, the very fact that human beings participate in nature means that human culture is a natural process. In sum, we should value Gordon Kaufman's treatment of the meaning of nature as, in some sense, bifurcated. Kaufman points out that the concept of nature has come to be portrayed as a "double entendre," with humans at home in nature and yet above it.[13]

Two tensions in these definitions of nature

Theologically speaking, both of the above definitions are integral parts of an understanding of nature. Therefore, in order to resolve the conflicts that are present between these two definitions of nature, some of the structural elements of this "double entendre" must be understood. Interestingly, we perhaps already can understand how this step will lead to the final goal of understanding the relation between a theology of culture and nature. For the following is not a discussion of nature in its essence, but instead a reflection upon how to identify and conceptualize the essence of nature—yet conceptualization is in some ways a cultural phenomenon. Thus, I now turn to a delineation of two tensions that participate in the ambiguity of the concept of nature: first, a tension in what it means to know nature;

and second, a tension in the understanding of the human relationship with nature.

The first tension comes from speculation upon how the essence or the ontological import of nature can be accessed. In other words, the question that must now be asked is how we are able to know nature. We are confronted with an epistemological question regarding our intuition of nature reminiscent of the problem Kant seeks to answer in the *Critique of Pure Reason*; namely, the question of the conditions for the possibility of any knowledge—essential or phenomenal—about the world we presume to perceive through our senses. Therefore, this first tension in the definition of nature finds concrete manifestation in the ambiguity of the description of nature as either a mechanistic and quantifiable object, or as that which is untamed by human technique—as vibrant, as awesome.

If the first tension is in terms of how we come to know nature both in form and content, then the second tension is centered on how we human beings come to relate to nature. This second tension is a bit more complex, as might be surmised by the fact that the definitions of nature are often reducible to the relationship we assume humankind is to have with nature. This tension is not epistemological, in that it is not based on our ability to comprehend or make conceptual descriptions of nature. Instead, this second tension is anthropological, because it develops in light of our conception of the human condition. We have already encountered the concrete example of this tension in certain aspects of Kaufman's "double entendre": humanity is a part of nature, yet humanity transcends nature. In religious and theological circles, the question of the human relationship with nature has been much discussed as a consequence of Lynn White's lecture published in *Science*, "The Historical Roots of Our Ecologic Crisis."[14]

The problem that the second tension confronts is this: what is primary in theological anthropology—participation or transcendence? Neither answer seems tenable on its own, as exemplified in Alfred Crosby's book, *Ecological Imperialism*. Crosby explains the background, propagation, and ultimate dominance of invasive European plant and animal species throughout temperate zones around the globe. While Europeans brought cultural artifacts and institutions which supplanted their counterparts in the native societies of colonized lands, there was a similar conquest occurring—in some cases by design, in others by accident—on the natural level. The historical importance of these "natural" transplants are paramount, such that Crosby assumes anyone attempting to explain the success of European advance must not only take into account the "demoralization and often the annihilation of the indigenous populations," but also "must explain the stunning, even awesome success of European agriculture," including newly introduced crops, animals—and concomitantly the weeds—that transformed naturally occurring ecosystems in their own image. Thus, Crosby sets forth a dialectic between culture and nature: culture (in the form of European expansion) stands over and influences the so-called natural surroundings, even as culture (in the form of native societies) is often helplessly and inextricably present within the overall natural sphere. In the con-

Already, a clear break between the human sphere and nature may be seen, based on the presumption that nature is bereft of teleology and a matrix of value. Teleology and value are based in culture and are, thus, at home only in human cultural structure.

temporary world, there are similar situations showing the continuing ambiguity of the human relationship with nature, from the problem of introduced Zebra mussels in the Great Lakes, to the invasion of North American coastal salt marshes by the Eurasian invasive plant species *Phragmites australis*, to the alteration of the culture of the Hill peoples of Orissa in light of a change in their natural world.[15]

Of history in nature, and nature in history

At this point, two very different tasks have been accomplished. First of all, a Tillichian theology of culture has been described. Secondly, the fact has been set forward that we often have two definitions of nature. Not only has the content of these definitions been summarized, but also the two tensions structurally working behind them. Now, I would like to move to another structural question: what stands at the crux of these two tensions? In answer, I would like to suggest that it is history that stands between the two. Further, in order to understand nature, the role that history plays in both nature and humanity must be understood. In order to accomplish this task, I would like to first look at Gordon Kaufman's idea that humans are "biohistorical" beings, as defined through a description of the "theological problem of nature" in his influential article, "The Concept of Nature: A Problem for Theology." Next, I would like to explore briefly Jan Patočka's concept of history, particularly in light of his statement that history is both event and narrative. Patočka provides a helpful emendation for Kaufman's work. We find through Kaufman's work that human beings must relate to the world through the historical. Yet nature, in its relationship with culture, has some participation in history as well. Also, historicality can be understood both as event and narrative. Through this discussion of the historical, a better understanding is provided of both the above-described tensions. History, then, assists in better defining nature and, in so doing, points out the way that nature can be understood by a theology of culture.

History, as an aspect of the human condition, functions as the ground and ordering of value, as that which mediates the experience of life—in other words, as the ground of the cultural life within which humanity finds itself inextricably meshed.

Kaufman does not wish to construct an ecological theology in "The Concept of Nature," but instead attempts "to get clearer the structure, connections, and implications of the concept of nature as these bear on its theological employment."[16] As I have already said, Kaufman points out the ambiguity of the concept of nature. He explains that this double entendre illustrates the following:

> Nature appears to be a nonteleological, nonaxiological order within which emerges purposive and valuing activity.[17]

In other words, while nature can be viewed as a complex of processes and functions, this value-free system of nature participates in the creation and sustenance of a teleological order of value within which humanity finds itself. This participation by nature shows the unique problem that nature presents for theology. Nature, "which does not have built into it the dimensions of purpose, value, and meaning…," is a backdrop for human life.

> The notion of God, on the other hand, as an agent characterized by freedom and purposiveness and love, is based on the model of human freedom and agency as experienced within society and culture.[18]

Already, a clear break between the human sphere and nature may be seen, based on the presumption that nature is bereft of teleology and a matrix of value. Teleology and value are based in culture and are, thus, at home only in human cultural structure.

Until the modern era, God and nature could be related to each other through the theological concept of creation—meaning, a finite nature dependent on an infinite God. However, the Enlightenment ushered in a conception of nature as infinite. The conception of nature as infinite is present in the second definition of nature, insofar as this definition sees nature as an all-encompassing totality of past, present, and future processes and objects. Because our worldview cannot have two infinites, the conceptualization of nature as infinite initiated a struggle between the concepts of God and nature. But in this struggle, notice that human persons remain, in some sense, transcendent of nature. To justify this transcendence, Kaufman highlights the importance of humanity as historical—in other words, as developing out of social and cultural processes in addition to biological ones. Borrowing from Hegel, Kaufman sees that freedom, morality, and consciousness develop only in light of history, meaning that humans have "another, new 'historical nature.'"[19] In sum, the importance of history must be recognized through the demarcation of humankind as distinctively "biohistorical." To be sure, human beings are shaped through evolutionary and biological processes. However, as Kaufman writes:

> In significant respects, thus, our historicity...is a distinctive mark of our humanness: we are beings shaped decisively by a history that has given us power ourselves to shape future history in significant ways.[20]

The conclusion is the following: humans, as biohistorical beings, by necessity interface with the world through the historical. Certainly, humans have a natural aspect, but transcend the natural through a dimension of history. History, as an aspect of the human condition, functions as the ground and ordering of value, as that which mediates the experience of life—in other words, as the ground of the cultural life within which humanity finds itself inextricably meshed. Thus, Kaufman—by claiming that humans are biohistorical—is asserting the following:

> ...that it is, above all, the high development of our historicity that gives our existence its most distinctively human character.[21]

This insight into the historical gives insight into the problem of what was described as the second, anthropological tension in the definition of nature, by providing an avenue to overcome the apparent antinomy presented in that tension. Indeed, in some respects the human is participant in nature and continuous with it, yet the human is able to transcend nature in some way, by virtue of the historical.

Yet, we still have not found an understanding of the first tension described above, but have only discovered an avenue toward comprehending the second. In other words, we use the historical to show how humans can be both participating in nature and simultaneously transcendent of it. However, this difference does not show how we can understand nature in terms of our first tension—in part because we have not explored the relationship between nature and historicality. History acts as ground of cultural structures and forms—but is history itself mediated through culture, and is there a sense in which nature also is mediated by historicality? With this question, we are left with a question concerning Kaufman's conception: could value or freedom—regarded as manifested through culture—be found within nature qua nature? Could history not in some way ground value and freedom within nature, just as it has done within the human cultural sphere?

Jan Patočka's *Heretical Essays in the Philosophy of History* might be able to assist us at this point. Patočka, in a work heavily influenced by Husserl and Heidegger, seeks to describe the transition from what he terms as the prehistorical to the historical. Within this movement from one to the other, we go from a naïve acceptance of nature in the prehistorical to a "problem of the natural world" present in the historical.[22] Writing in a Heideggerian vein, Patočka states the following:

> The things we encounter are grasped as themselves, though not independently of the emergence of essential concealment into openness. In the play of manifestation/unconcealment, they show themselves as what they are, thus demonstrating their seriousness. Their manifestation, however, is itself historical, in two ways: as the uncovering of what is and as the emergence of the structures of being which thus cannot stand out into openness other than historically.[23]

The natural world, by participating in unconcealment (a concept illuminated by Heidegger in such works as "The Question Concerning Technology"[24]), must be contextualized within history. The natural world is, in some sense, also biohistorical—at least after the human has gone through the passage from the naïve prehistorical to the historical.

However, this recognition of the historicality of nature does not negate Kaufman's hypothesis that the human person holds a unique, transcendent place in the world. Rather, through Patočka's differentiation between the meaning of events and the meaning of narratives we find how humans transcend nature.

> However, the meaning of a narrative about events is different from the meaning of what is narrated. The meaning of events is an achievement of those who act and suffer, while the meaning of a narrative lies in understanding the logical formations pointing to those events.[25]

The historical human comes out of a development of a narrative that mediates the historical event; for Patočka, the *polis*, the concept of *polemos*, the development of Christianity, and finally the modern scientific/mathematical outlook all have decisively influenced the narratives that are overlaid on nature and the events of history. Meanwhile, nature still participates in history as event, thereby allowing the human relationship to nature to be conducted within the events of the world, while we are able to transcend the historicality of event through the human ordering of the historicality of narrative.

A better understanding of nature can perhaps be developed if no attempt is made to collapse the meaning of history as event into that of history as narrative. Indeed, by assuming that history as event can be present in nature qua nature, then nature is seen to participate at least indirectly in the structuring of culture, because culture is developed on the basis of history. At the same time, human persons are are seen to be distinct from nature in their historicality. This relationship between humanity, nature, and history has ramifications regarding the two tensions mentioned above, for implicit in those two tensions is the fact that nature is conceptualized both as necessarily mediated through culture and yet as independent of culture. In order for an understanding of the second tension to be comprehended in light of the concept of biohistoricality, then, we can be seen to relate to nature through history. At the same time, it must be accepted that there is a bifurcation within the concept of history between the event and narrative, with nature participating in the event of history but not in the narrativity of history. Therefore, neither participation nor transcendence can have the final word in our relation to nature; instead, both are participants in a dialectic of history. As a result of this dialectic, the first tension finds new significance. I would like to suggest that a historical understanding of freedom and teleology are aligned with the narrative, while value and meaning are embedded in the events of history themselves (unfortunately, due to space, we cannot explore this alignment further). By virtue of these alignments, we can understand nature mediated in terms of human freedom and teleological development as found in the enculturedness of history as narrative. We are also able to experience (within this cultural embeddedness of history) nature directly in terms of value and meaning as found in history as event. In other words, to say that we are simultaneously historical and natural beings can make sense only insofar as the historical can attempt to ascertain the natural through both dimensions of history: through the separateness of culture in terms of the transcendence found in the historicality of narrativity and through the participation and presence of both nature and culture in the historicality of event.

Just as new meaning is found within the structural features (as seen in light of two tensions) of the conception of nature, renewed meaning and complementarity are also found in the two definitions of nature. By virtue of this grounding of culture in history, a theological understanding of nature can be utilized that comes from both definitions given above: (1) nature in its function as raw material and Other, and (2) nature as totality and continuous with the human cultural sphere. It is here that the potential religious dimension present within nature begins to be appreciated, as seen in an insight from Ezarim Kohák's important work, *The Embers and the Stars*. Kohák sees that value and meaning enter into the world through an inbreaking of eternity into time. This vertical dimension appears in the natural world, insofar as the natural world is a world bounded in time and history as event. Therefore, the divine is found in the inbreaking of eternity into the events of history, into a dimension of history in which nature and humanity are conjoined.

Further, the historicality of nature is found to allow nature to be the bearer of value, insofar as nature participates in the inbreaking of eternity. Nature acts as an avenue for a recovery of value, since, as Kohák writes:

> To recover the truth of value it is crucial to bracket the reductive framework of temporal sequence and to see being in its reference to the eternity which ever intersects with time, defining the now within it. Within time, that now would be indistinguishable from the endless series of such nows. It stands out as the moment in which eternity intersects time.[26]

Thus, nature has what Kohák calls a moral sense—something to which we can enter into relation in time:

> The moral sense of nature, and not that alone, but all whereof we have spoken, is not its own, generated by its processes. It is the presence of God—the Christians would speak of the Holy Spirit—and a gift of Nature's Creator. Nature's gift to humans, in turn, is not its own but God's gift which nature mediates.[27]

Works cited:

Crosby, Alfred W. *Ecological Imperialism: The Biological Expansion of Europe, 900-1900.* Cambridge and New York: Cambridge University Press, 1986.

Dash, Jagannath. "Ecology, Culture, and the Changing Behaviour of the Food-Gathering and Hunting Peoples." *Journal of Human Ecology* 9, no. 6 (1998): 545-49.

Gilkey, Langdon. *Nature, Reality, and the Sacred: The Nexus of Science and Religion.* Minneapolis: Fortress, 1993.

Gill, Robin. "Religion and the Environment." *Theology* 102 (November/December 1999): 408-415.

Heidegger, Martin. *Discourse on Thinking.* Trans. John M. Anderson and E. Hans Freund. New York: Harper Torchbooks, 1966.

_____. *The Question Concerning Technology and Other Essays.* Trans. William Lovitt. New York: Harper Torchbooks, 1977.

Kaufman, Gordon. "A Problem for Theology: The Concept of Nature." *Harvard Theological Review* 65 (1972): 337-66.

_____. "Ecological Consciousness and the Symbol 'God.'" *Buddhist-Christian Studies* 20 (2000), 3-22.

Klink, William H. "Ecology and Eschatology: Science and Theological Modeling." *Zygon* 29, no. 4 (December 1994): 529-545.

_____. "Nature, Technology, and Theology." *Zygon* 27, no. 2 (June 1992): 203-20.

Kohák, Erazim. *The Embers and the Stars.* Chicago: University of Chicago Press, 1984.

———. "Varieties of Ecological Experience." *Environmental Ethics* 19, no 2 (Summer 1997): 153-71.

_____. and John Lachs. "A Dialogue on Value." *Journal of Speculative Thinking* 5, no. 1 (1991): 1-24.

Oates, Joyce Carol. "Against Nature." In *On Nature: Nature, Landscape, and Natural History*, ed. by Daniel Halpern, 236-43. San Francisco: North Point Press, 1987.

Oliver, Harold. "The Neglect and Recovery of Nature in Twentieth-Century Protestant Thought." *Journal of the American Academy of Religion* 60 (1992): 379-404.

Ovid. *Metamorphoses*. Vol. 2. Loeb Classical Library. Trans. Frank Justus Miller. Cambridge: Harvard University Press, 1984.

Patočka, Jan. *Heretical Essays in the Philosophy of History*. Trans. Erazim Kohák. Chicago and LaSalle: Open Court, 1996.

———. *Le Monde Naturel Comme Problème Philosophique*. Trans. Jaromir Danek and Henri Declève. The Hague: Martinus Nijhoff, 1976.

Santmire, H. Paul. *The Travail of Nature: The Ambiguous Ecological Promise of Christian Theology*. Minneapolis: Fortress, 1985.

Tillich, Paul. *The Courage to Be*. New Haven: Yale University Press, 1952.

———. "On the Idea of a Theology of Culture." In *What is Religion?*, ed. by James Luther Adams, 155-81. New York: Harper Torchbooks, 1969.

———. *Theology of Culture*. Ed. Robert C. Kimball. New York and Oxford: Oxford University Press, 1964.

White, Lynn, Jr. "The Historical Roots of Our Ecologic Crisis." *Science* 155 (10 March 1967): 1203-7.

Endnotes:

1. Ovid, p. 83.

2.Tillich, "On the Idea," p. 155.

3. Tillich, *Theology of Culture*, p. 27.

4. Tillich, "On the Idea," p. 174.

5, Ibid., p. 188.

6. Tillich, *Theology of Culture*, p. 5. Further illuminating this concept, Tillich explains the meaning of "depth" by saying that depth "means that the religious aspect points to that which is ultimate, infinite, unconditional in man's spiritual life" (p. 7).

7. Kohák, "Varieties," p. 167.

8. Ibid., p. 153.

9. Oliver, pp. 379-80.

10. Oates, p. 236.

11. Kaufman, "Problem for Theology," pp. 343-5. As Kaufman sees it, "nature functions in much the same way as Kant's 'world.'" The main difference is that "nature is concrete in a way that world is not" (p. 344). Kaufman reminds us that, in addition to the inexperienceable whole to which nature refers, it can also denote the concrete "qualities or dimensions" of the whole.

12. This calls to mind Tillich's exposition on being—as well as the religious ramifications of this—in *The Courage to Be*, esp. ch. 2 and 6.

13. Kaufman, "Problem for Theology," pp. 339ff.

14. See the opening chapters of Santmire, *The Travail of Nature*, where Santmire gives a similar dichotomy, showing the difference between the ecological motif and the spiritual motif. Also of interest is Gill, who highlights some of the implications and problems of White's article, particularly the fact that it "has been very effective in alerting theologians to some of the unintended consequences of their ideas" (Gill, p. 409).

15. Regarding the latter, Jagannath Dash has commented, "The physical environment…is in all possible ways related to the culture and behavioral patter of a forest-based community. Therefore, any change in the physical environment has direct or indirect bearing on the way of life of a forest-based people" (Dash, p. 545). In fact, I imagine that works like Crosby's show this to be true for many, if not all, societies.

16. Kaufman, "Problem for Theology," p. 338.

17. Ibid., p. 343.

18. Ibid., p. 346.

19. Ibid., p. 363.

20. Kaufman, "Ecological Consciousness,'" p. 11. Note that Kaufman's terminology shifted slightly from his initial work in "The Concept of Nature," where he refers to human beings as "historico-natural," to his

later works, where he refers to them as "bio-historical." While a discussion on the significance of this change would be of interest, let me simply note that the two terms taken together seem to point to a parity between the historical and the natural, at least in terms of human development.

21. Kaufman, "Ecological Consciousness," p. 12.

22. In another work, Patočka describes the philosophical problem of the natural world in ways that are reminiscent of Heidegger, as well as the epistemological problem we confront in the present paper: "*L'homme moderne n'a pas du monde une conception unifiée. Il vit dans un monde double: dans son environnement, qui lui est naturellement donné et, en même temps, dans le monde que depuis l'ère moderne créent pour lui des sciences fondées sur ce principe que les lois de la nature sont d'essence mathématique.*" *Le Monde Naturel Comme Problème Philosophique*, p. 1; see also pp. 5-6.

23. Patočka , *Heretical Essays*, pp. 9-10.

24. Technology of any type is a bringing-forth, a presencing that occurs when something that is previously concealed is brought into unconcealment—in sum, it finds itself as part of the ground of causality as *alētheia*, or revealing. Technology in its instrumental sense is seen to be based on revealing: "The possibility of all productive manufacturing lies in revealing" (Heidegger, *The Question Concerning Technology*, p. 12). This means that technology is not simply a means, but also can be a bringing-forth in the realm where the truth (not simply the correct) happens. However, modern technology is not only a revealing, but a challenging forth that makes its object into a "standing-reserve"—and it is this challenging that bring both the danger and the possibility of a saving power, simultaneously.

25. Patočka , op. cit., p. 28.

26. Ibid., p. 180.

27. Ibid., p. 183.

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Interpreting the Book of Nature in the Protestant Tradition

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The doctrine of creation has been underdeveloped in the Protestant dogmatic tradition, often preventing substantive dialogue between theology and science. In this essay, the author argues that the "Two Books" theory of revelation should be employed to reconceive creation in contemporary Protestant thought. After a brief historical survey of the "Two Books" theory, Thomas Torrance's theology of nature is presented as a paradigm for developing a scientifically astute doctrine of creation. The article concludes with a constructive proposal for a new Protestant "hermeneutics of nature."

In this essay, I offer a brief overview of the "Two Books" theory in the Protestant tradition with programmatic reflections for a contemporary reformulation of the theory in conversation with Thomas Torrance's theology of nature. While leading contemporary Roman Catholic (e.g., von Balthasar 1982) and Eastern Orthodox theologians (e.g., Schmemann 1998) maintain a cohesive sacramental variation of the "Two Books" theory, Protestant theology lacks this coherence because of the rupture between natural and revealed knowledge of God that was internalized in post-Enlightenment theology. An argument is made that the "Two Book" theory should be reformulated as a mode of Protestant systematic theology that expands traditionally text-based hermeneutics to include the "text of nature," taking scientific research and the interdisciplinary status of theology with the utmost seriousness.

The first three sections of this article are a historical narration of the "Two Books" theory from the Cappadocians to John Calvin and Karl Barth, paying close attention to the way the theory has evolved over time and in relation to changing scientific perspectives. After Calvin, a late medieval theologian in many respects, the theory was reformulated in response to the discoveries of science, the critiques of traditional religion and the challenges of evolving cultural contexts during the rise of modernity in Europe. There are several important "turning points" in the evolution of Protestant thought through its engagement with the Enlightenment including Francis Bacon's subtle inversion of the two "books" and the radically subjective grounding of Schleiermacher's onto-theology. The internalization of these critical developments within Protestant theological method drove Karl Barth fully to reject natural theology as a valid method for acquiring true, revelatory knowledge of God.

Karl Barth's student, Thomas Torrance, sought to restore the rigorous interpretation of the Book of Nature into Protestant systematic theology. Torrance's interactionist model of relating theology and science is explained in Section Four, providing a paradigm for a contemporary reformulation of the "Two Books" theory. The Fifth Section contains my own constructive reflections on the necessity of developing a "hermeneutics of nature" as being integral to the task of constructing a contemporary systematic theology in the Protestant tradition, one that is in constant critical and dialectical dialogue with scholarship in the natural and social sciences.

The extended argument for the authoritative normativity of the Book of Scripture in the Christian tradition throughout this article may seem unusual to many participants in the science and religion dialogue, who are used to an "ecumenical" engagement with a plurality of religious and humanist traditions. The particular theological claim that is argued here is that the Book of Nature must be interpreted through the special disclosure of God in Christ as revealed in Scripture, thus giving special revelation primary normative authority over the natural revelation of creation. Part of the brilliance of Torrance's theology of nature (described here in Section IV) is that these two sources of revelation join together harmoniously when viewed through a unitary epistemological perspective.

Barth's repudiation of natural theology was in large part a repudiation of the neo-Protestant reductionism of all theology to anthropology, which was being employed as a theological justification for the oppressive Nazi regime.

A justification for the religion-and-science discourse to engage the particularist revelatory claim of the Protestant tradition is made for three reasons: (a) the authoritative power of sacred Scripture in the Western monotheistic traditions, (b) the Bible's classic status in framing the early modern worldview in Western Europe (see section III), and (c) the theory-laden nature of all theological and scientific scholarship. With respect to scriptural authority, conservative confessional theologians within the Judeo-Christian-Muslim religious matrix all grant authority to their respective sacred texts (all of which thematically overlap in many respects). Although claiming these sacred texts as authoritative in a given religious tradition is a circular argument, recognizing this formal similarity among the different Western monotheisms opens the possibility for inter-religious dialogue about the function of scripture in theology and public discourse.

Jewish, Christian, and Muslim religious thinkers need to stay in conversation about how they relate the Two Books of Scripture and Nature within their religious traditions. Western culture and modern science has been shaped in no small way by the metaphysical narratives of the Bible, providing a second justification for the particularist approach toward revelation within one religious tradition; this is why David Tracy considers the Bible a "religious classic." The theory-laden nature of theological and scientific writing is the third justification for an inclusion of a sacred text as a normative measure of truth in systematic theology.[1] Contemporary thought in science, philosophy and religion suggests that there is no neutral, de-contextualized mode of theoretical discourse since all humans are bound by interpretive traditions, prejudices and social institutions.[2] Therefore, as a Protestant theologian I am trying to explore the resources within my own tradition for a constructive theology of nature that I call a "hermeneutics of nature," while making my arguments vulnerable to a broader scientific and inter-religious public. A sweeping historical narrative (Sections I-III) is essential to contextualizing Torrance's own theology of nature (Section IV) and my own programmatic suggestions toward a Protestant "hermeneutics of nature" (Section V).

I. Contemplating the "Book of Nature" in Greek patrology: St. Basil's *Hexaemeron*

Implied in the literature of the New Testament (e.g., Acts 17:24; Romans 1:19,20; Hebrews 11:3), the "Two Books" theory finds early expression in the patristic period, especially in the East. From the earliest writings, liturgies, and practices of the Eastern Christian Churches, it was believed that God could be known from two principle sources: the Book of Scripture and the Book of Nature. This "Two Books" theory claims that the natural world that was created by God can be considered in a certain sense a "Book" that reveals a natural knowledge of its very Creator, complementing the redemptive revelation of the Book of Holy Scripture.[3] Both the Book of Scripture and the Book of Nature were authored by the Divine breath, according to the biblical literature (e.g., Gen. 1, 2; Psalm 104:29,30; 1 Tim. 3:16). Since God created the whole world and called it good, even after the fall, all dimensions of physical reality bear the mark of the Creator, even after the Fall..

There is a long theological lineage of the "Two Books" theory during the patristic and medieval period in both the East and the West. For example, Western theology has a sustained line of theological reflection on the "Two Books" theory from Tertullian to Augustine and Hilary, all the way to the preeminent thirteenth-century Scholastic theologians, Thomas Aquinas and Bonaventure.[4] An academic monograph on the "Two Books" theory in Western and Eastern Christian historical theology is long overdue. Because of the limitations of space and the Protestant and modern orientation of this article, only one figure will be briefly treated from the patristic and medieval period—St. Basil, the great fourth-century Cappadocian theologian who, together with Gregory of Nyssa and Gregory Nazianzen, had a tremendous impact on the theology of John Calvin.

The visible features of nature were thought to be an adumbration of the invisible God in the Greek patristic writers who thought it possible "to discern, in and through each created reality, the divine presence that is within and at the same time beyond it. It is to treat each thing as a sacrament, to view the whole of nature as God's book."[5] Using the trope of a revelatory literary text when discussing the natural world was common in Plato's *Timaeus*, and expanded in the writings of many of the early Christian writers including Origen and Basil in their *On First Principles* and *Hexaemeron*, respectively.

From "a work of art"[6] to the text of "a harmonious symphony,"[7] Basil describes nature as an art object in his commentary on the first few chapters of Genesis which is entitled the Hexaemeron, a work that became normative for nearly all subsequent Christian hexaemeral literature. One of the most memorable analogies he employs is comparing nature to a school:

> ...where reasonable souls exercise themselves, the training ground where they learn to know God; since by the sight of visible and sensible things the mind is led, as by a hand, to the contemplation of invisible things.[8]

Whether Basil talks about nature as a book, a painting or a school, he sees it as a species of language. Thus, all of creation is itself a kind of code or language that may be deciphered. The Book of Nature, in Basil's writings, can be best illustrated in the eucharistic liturgy. Creation itself becomes a text that unfolds before the exegete who expounds its inner meaning in the context of liturgy, when the elements of creation are offered back to God and identified with the body of Christ.

II. The "Book of Nature" in the Magisterial Reformation: the "theatre of God's glory" in Calvin

John Calvin continues in the spirit of Basil's hexaemeral tradition in his *Institutes on Christian Religion* (1559), by discussing the natural world as a "theatre of God's glory." Calvin makes a distinction, drawn earlier by Thomas Aquinas, between a valid yet partial knowledge of God available through observation of the world and a fuller knowledge of God resulting from God's decision to reveal himself in the person and work of Jesus Christ. In the *Institutes* Calvin writes:

> First, as much in fashioning the universe as in the general teaching of Scripture the Lord shows himself to be

simply the Creator. Then in the face of Christ [cf. 2 Cor. 4:6] he shows himself the Redeemer.[9]

God's revelation as Creator is consistent with the divine disclosure as Redeemer. Calvin's distinction between God as Creator (general revelation) and God as Redeemer (special revelation) is predicated on an acknowledgement of the integral interface between the Book of Nature and the Book of Scripture. Together the two books reveal this dual aspect of God in Christian theology—Creator and Redeemer.

Calvin's understanding of general knowledge of God posits a universal framework from which all people may discern glimpses of divinity through scientific investigation, whether they are within or without the Christian community. According to Calvin, all humans are endowed with a native "sense of divinity" (*sensus divinitatis*). Often this divine sense is activated by nature. Historian Susan Schreiner's masterful study on Calvin's doctrine of creation demonstrates his emphasis on the natural world as a "theatre" displaying the divine presence, nature and attributes. Calvin writes, "Men cannot open their eyes without being compelled to see him,"[10] demonstrating the plenitude of external witnesses to God. Through rational reflection on the majestic and mysterious structure of the natural world, scientists often experience a sense of awe "in the face of aesthetic powers, cosmic laws, and social orders."[11] Since Calvin thinks that the study of nature could reveal a natural knowledge of God, he encourages creativity in the arts and scientific investigation in a wide variety of fields including biology and astronomy.[12]

Once Calvin establishes a general knowledge of God, he immediately problematizes universal knowledge of God.[13] Although it is a natural knowledge of God that serves to deprive humanity of any excuse for ignoring the divine will (Romans 1:19), it does not reveal a saving knowledge of God.[14] Human thinking has been marred as a result of the fall, which according to Calvin applies to all dimensions of our humanity including our cognitive capacities (i.e., the noetic effects of the fall). Commenting on the *Institutes*, theologian Michael Welker claims natural knowledge of God is "a vague knowledge of a vague power that surrounds us in such a way that we can neither get a firm handle on it nor avoid it."[15] It is only through faith in Jesus Christ, according to Calvin, that this vague knowledge is shaped into concrete form. Thus, through special revelation, creation can be viewed as a reflection of God, providing partial resonances of this more exhaustive soteriological revelation. The Book of Nature confirms and extends our knowledge of God as our Father in the creation and governance of the world, complementing our knowledge of Jesus Christ our Mediator.[16] Thus, for Calvin the Book of Nature must always be interpreted through the lens of the Book of Scripture.

Barth's great students realize the inadequacy of his doctrine of creation and are in the process of reforming the Barthian heritage in Protestant theology— be it Moltmann with his Messianic eco-theology, Pannenberg with his philosophical theology of science,or Torrance with his theology of nature.

Throughout the *Institutes* Calvin works with a double paradigm of knowledge of self and knowledge of God. In the second edition of the *Institutes* (1539) Calvin states the order from knowledge of God to knowledge of ourselves is preferred.[17] This order of teaching, from knowledge of God to knowledge of self, is soon inverted through modern theology's attempt to begin with individual human subjectivity as the ground for justifying and interpreting divinity. By rejecting the Catholic tradition, Calvin and Luther's theological visions were already beginning a subtle shift towards a subjective orientation in theological method.

III. The Protestant encounter with modernity: from Bacon to Barth

The Protestant Reformation, along with nominalism and the new science, had a great impact on the intellectual climate of the seventeenth century. Debates about religious authority— essentially hermeneutical debates—were alive with great drama during these foundational decades of the modern scientific revolution. Intellectual historian R. H. Popkin argues persuasively that the seeds of modern skepticism are present in Martin Luther's rejection of the Catholic tradition because of his subjective certainty in a faith grounded solely in Scripture.[18] With the post-Reformation breakdown of church authority, a quest for certainty became the dominant epistemological issue in both theology and philosophy.[19] Modernity's quest for certainty, initiated in no small part by Martin Luther's radical rejection of traditional religious authority,[20] as well as the broadly Christian underpinnings of the scientific revolution illustrated in the pious motivations and writings of scientists like Robert Boyle and Isaac Newton,[21] clearly demonstrate an "unprecedented fusion" between Christian theology and early modern scientific thought.[22]

For example, Francis Bacon, son of a Calvinist mother and one of the founders of the new scientific approach of the seventeenth century, adopted and reformulated the "Two Books" theory. In *The Advancement of Learning*, he writes:

> God's two books are…first the Scripture, revealing the will of God, and then the creatures expressing his power; whereof the latter is a key unto the former.[23]

There is a subtle shift in language here, where the Book of Nature is seen as a hermeneutical key for the interpretation of the Scripture. Moreover, in Bacon's broader thought a pattern of differentiation may be observed, with scientific and religious knowledge tending toward a duality. The emphasis on "creatures expressing [God's] power" also anticipates the anthropocentric character of most modern thought. This movement continues in the inward turn to the depths of the self in Descartes' and Schleiermacher's onto-theologies, be they rational or romantic.

When Christian theology is confronted with early modern thought, it experiences a shift towards a radically subjective orientation for theology. This shift is most clearly illustrated in French Catholic philosopher René Descartes' method of radical doubt in his *Meditation on First Philosophy*. Descartes' symbolic "turn to the subject" with faith in unaided reason alone to understand God transformed the way the Book of Nature was interpreted.[24] In these six meditations Descartes seeks to give epistemic justification for the existence of self, God and the external world through individual ratiocination alone in order to find a "certain and unshaken" foundation for all knowledge.[25] Thus, as a foundationalist, Descartes was in search of a universally shared foundation of faith provided by human reason and the canons of science. In his third meditation, he develops an ontological proof for the existence of God based on a causal deductive analysis of the idea of infinite perfection within his own subjective reflection.[26] Anchored in his own subjectivity, Descartes' deductive argument establishes knowledge of God that is clear to his own individual intellect, without connecting this knowledge to the natural non-human world.

This decisive shift toward a subjective mode of theological argument, combined with the disenchantment of the natural world is connected with other cultural developments. A move from theism to deism (which denied a personal relationship between the divine and the world) took place in the early modern period, as Newtonian physics was increasingly established as the sole valid scientific vision of the seventeenth century. These theoretical shifts began to weaken the Christian apologia against philosophical atheism.[27] This emerging naturalistic tendency within deism would find true philosophical acumen in David Hume.[28] Attacking William Paley's natural theology, Hume, in his *Dialogues Concerning Natural Religion*, remained skeptical about nature's ability to reveal God to humanity. Hume's critique of the metaphysical view of causality and his demolition of the argument from miracles advanced a skeptical naturalistic view of the world that awoke Kant from his "dogmatic slumber."

Also critical of the design argument in natural theology, Immanuel Kant, in his *Critique of Practical Reason* (1788), argues for a separation of science and theology (Emerton 1989). However, this could not shake his deep appreciation of the sublime in the natural world, especially in the interior moral life of human nature. He writes:

> Two things fill the mind with ever new and increasing wonder and awe, the oftener and the more steadily we reflect on them: the starry heavens above me and the moral law within me..[29]

Of these, it was not the beauty of the book of nature, but the moral law within that Kant thought pointed humanity to God. A bold attempt to reconnect the human subject with the transcendence inherent in and through the natural world was taken up in the German romantic theological synthesis of Friedrich Schleiermacher.

Friedrich Schleiermacher: Creation as the Word of God

Friedrich Schleiermacher shared Descartes' and Kant's turn toward individual subjectivity to anchor our understanding of God. He sought a post-Enlightenment, romantic alternative to the religious problematic of modernity. A product of German pietism and romanticism, Schleiermacher turned to human feeling as the primary interpretive lens for understanding the "Book of Nature." Since he conceived religion as fundamentally a human feeling of dependence on the totality of the universe, the religious dimension of individual experience became the locus for theological construction. Thus, knowledge of God encountered in the Book of Scripture and Nature is dogmatically valid only if it helps elucidate our individual and interior feelings of dependence on God. Although his emphasis on human dependence on God is a welcomed revision of the Enlightenment anthropologies that emphasize the autonomy and independence of the individual, creation is still interpreted through the medium of individual feeling.

In *The Christian Faith*, Schleiermacher systematically reinterprets all of the classical Christian doctrines (i.e., "accounts of the Christian religious affections set forth in speech") by assessing how well they are able to clarify the human "consciousness of being absolutely dependent, or, which is the same thing, of being in relation with God."[30] When Schleiermacher treats the doctrine of creation, he seeks to prune it of fruit that has not grown from interior piety. For example, he writes:

> [T]he doctrine of Creation is to be elucidated pre-eminently with a view to the exclusion of every alien element, lest from the way in which the question of Origin is answered elsewhere anything steal into our province which stands in contradiction to the pure expression of the feeling of absolute dependence.[31]

Thus, the question of the historicity of the six day creation account in Genesis is not essential to Christian dogma, because "our feeling of absolute dependence does not gain thereby either a new content, a new form, or clearer definition" from this information.[32] While *creatio originalis* is seen as irrelevant to our immediate religious experience, *creatio continua*, or God's preservation of the world, is viewed as a helpful aspect of the doctrine of creation since God continues to reveal, redeem, and reconcile humanity in the moment through a diachronic and developmental process.[33]

Although some aspects of the doctrine of creation do not need to be articles of faith in Schleiermacher's theology, God does reveal himself through creation, "the word of God" which he spoke into existence.[34] By focusing on the spoken word as the vehicle of God's creative activity, Schleiermacher expresses the "Two Books" theory through a restatement and expansion of Lutheran "Word of God" theology. Schleiermacher writes, "the world itself, since it came into existence through the spoken work, is the word of God."[35] The "Books" ofScripture and Nature are both words spoken by the same God.

Who is this God who we feel through our embodied existence in the natural world? Accepting the "limit notions" of Kant, Schleiermacher's *Dialectics* develops a theory of "transcendent postulates" that provides a theological opening beyond Kant's understanding of God as a necessary and regulative "fiction."[36] Philip Clayton argues that Schleiermacher's dialectical strategy exposes "signs of transcendence" which point beyond our "limit notions" toward our transcendent ground.[37] Conceiving God as a transcendent ground brings God and nature into closer proximity. For example, in his *On Religion*, Schleiermacher replaces the rhetoric of an all powerful personal God with terms like infinite, transcendence, world soul, and the universe. This shift toward natural metaphors to talk about transcendence is indicative of a broader pantheistic tendency toward earth-worship during this romantic era.[38]

Throughout his career, Torrance has sought to work out, in some measure, the interrelation between Christian theology and natural science and, thus, to begin to clear the ground for rigorous Christian dogmatics expressed within the contingent rational order.

In summary, Schleiermacher shows a naturalization of the "Two Books" theory, inaugurating a paradigm of non-reductive naturalist Christian theology—naturalist, because of his rejection of supernaturalism; and non-reductive, because of his recognition of an authentic experience of the divine. Schleiermacher's naturalization of theology via the human feeling of absolute dependence takes place, ironically, through a reduction of the idea of divine creation.[39] As a result of this spirit of German idealism, classical theological distinctions between creatures and the Creator, humans and the non-human world, began to be deconstructed, while the search for divinity was restricted to a pious subjectivity without objectivity.

Karl Barth: Creation as external ground of the Covenant

In the twentieth century, neo-Reformed theologian Karl Barth (1886-1968) rejected this subjectivist strand of modernist thought, mounting the greatest contemporary critique of natural theology. Through robust doctrines of revelation, Christology and election exposited by a method of dialectical realism in his *Church Dogmatics*, Barth sought to place the primary focus of theology back onto God in his Triune objectivity. For Barth, we come to know God not through our moral, intellectual or religious labor, but through God's sovereign and loving initiation of human faith in Jesus Christ, a miracle of grace.

Barth saw the articulation of natural theology as a systematic attempt to infer God through our native human capacities and experiences, as thoroughly misguided since God reveals himself definitively in Jesus Christ. Natural theology's clearest expression was the Roman Catholic analogical tradition of theology, especially its employment of the *analogia entis* (analogy of being) in fundamental theology. Barth begins his *Dogmatics* with a vehement criticism of Roman Catholic analogical theology:

> I regard the *analogia entis* as the invention of Antichrist, and think that because of it one can not become a Catholic.[38]

Despising the neo-Platonic elements in the *analogia entis*, Barth argued that sin has made human reason by itself simply incapable of knowing God. In his debate with Brunner, he argued that there was no point of contact or continuity between humanity and God. George Hunsinger instructively writes, "Falsifying abstractions, neutral generalizations, and non-existent capacities" are three of the critical weaknesses with natural theology that led to Barth's wholesale rejection of this paradigm.[40]

Barth's polemic against natural theology was intensified and brought closer to home through a similar analogical approach in the German neo-Protestant tradition, associated with Schleiermacher and his progeny, including Ritschl, Herrmann, and Troeltsch. What united all these theologians was their assumption that humanity has within itself the natural capacity to lay hold of divine revelation. The continuity rather than the discontinuity between God and humanity was their salient emphasis—God is not transcendent from creation, but instead is immanent in human religious experience. Barth's repudiation of natural theology was in large part a repudiation of the neo-Protestant reductionism of all theology to anthropology, which was being employed as a theological justification for the oppressive Nazi regime.

Instead of searching for analogies within created reality, be they human or non-human, Barth gives systematic priority to the Christological doctrine of election, subordinating the doctrine of creation in the shape of his dogmatics.[41] Barth interprets the "Book of Nature" as the "external ground" of God's covenantal history with humanity:

> [C]reation is the construction of the space for the history of the covenant of grace.[42]

Creation becomes the space and stage on which the great acts of redemptive history are played out according to God's sovereign will.

Creation is mediated to humanity through the humanity of Jesus Christ. Barth's Christology follows a Chalcedonian pattern which is "constitutive with respect to salvation, and regulative with respect to interpretation." [43] Barth maintains the soteriological logic of Chalcedonian Christology in the spirit of Irenaeus and Athanasius—God fully heals what he fully assumes. Christology's regulative role in the interpretation of nature is overly dominated by humanity's pre-temporal election in Jesus Christ. What are the implications of humanity's election, as revealed in the incarnate Jesus Christ for the non-human world?

Barth emphasizes the incarnate Jesus Christ over Christ as *logos asarkos*, missing a critical connection between humanity and nature through a *logos* Christology. The privileging of the pre-temporal election of humanity in Jesus Christ places creation in a secondary role in the divine economy.[44] H. Paul Santmire argues that the cumulative force of Barth's doctrine of creation demonstrates its instrumental function in God's work of reconciliation and redemption.[45]

In summary, Barth seeks to solve the divorce between creation and redemption in Protestant thought through his Christological doctrine of election. Rejecting any native connection between God and creation, Barth argues that Jesus Christ's humanity is the sole point of contact between God and humanity. Because Jesus' humanity is never formally connected to nature, nature is overshadowed by God's covenant with humanity. Moreover, since Barth did not finish his dogmatic volumes on redemption, no clear and fully developed picture of his understanding of the *creatio nova* has been left. After Barth, interpreting the "Book of Nature" remains a problem.

It was up to the next generation of Protestant theologians to resolve these open questions; however, their proposals would often bear the mark of the Barthian legacy—the irreducible integratedness of Christology and a theology of creation. Although Barth decided not to "tackle the obvious scientific question" posed by the doctrine of creation, deciding instead to employ a circular repetition of the creation saga, much like Wagner's recurring leitmotif, he saw the dialogue between science and religion as holding promise:

> I am of the opinion, however, that future workers in the field of the Christian doctrine of creation will find many problems worth pondering in defining the point and manner of this twofold boundary [between theology and science].[46]

When placed in the historic context of Nazi Germany, Barth's rejection of natural theology is understandable, but its implications for theology's public function and inter-disciplinary status were unfortunate.[47] In many ways his great students realized the inadequacy of Barth's doctrine of creation and are in the process of reforming the Barthian heritage in Protestant theology—be it Moltmann with his Messianic eco-theology (1993), Pannenberg with his philosophical theology of science,[48] or Torrance with his theology of nature.[49] It is Scottish theologian Thomas Torrance whose model I choose to engage constructively, because he is the most nuanced interpreter of Barth, maintaining his Chalcedonian pattern of Christology while augmenting Barth's project by presenting an interactionist model of science and religious discourse that provides interdisciplinary space for the two disciplines to act as mutual correlatives and correctives.

Torrance's theology of nature provides a framework through which one can synthesize theological and scientific knowledge, to include the cosmos as well as humanity in a genuine theology of the Word of God.

IV. Torrance's theological science: a new interpretation of the "Book of Nature"

Thomas Torrance, who studied theology with Karl Barth at the University of Basel, reformulates his teacher's radical critique of *theologia naturalis* through reclaiming the classical Calvinist "Two Books" paradigm. While maintaining Barth's Trinitarian-Christocentrism, Torrance develops Barth's theological program in a manner that is fundamentally more receptive to the natural sciences. Where Barth freely acknowledges his failure substantively to engage the natural sciences in his *Church Dogmatics*, Torrance's canon has sought to make up for this absence, demonstrating that the science-and-theology discourse is essential to the task of Protestant dogmatics. Moreover, theology when properly conceived can be considered a science in a real sense.

Torrance finds a consonance between science and religion that he sees as fruitful for the future of theology. Throughout his career, Torrance has sought to work out, in some measure, the interrelation between Christian theology and natural science and, thus, to begin to clear the ground for rigorous Christian dogmatics expressed within the contingent rational order. Torrance is able to unify the two disciplines through a unitary epistemology that seeks to move beyond the dualisms of modernity, including those introduced by Descartes, Newton and Kant.

Torrance works out of Barth's theological vision, respecting his high Christology, while working constructively on the doctrine of creation. Torrance clearly recognizes that natural theology, incomplete in itself, must be fulfilled in revealed theology. Theology is Christologically determined for Torrance, as for Calvin and Barth, working from Christ outward. It is only through the lens of Christ as revealed through the "Book of Nature" that one is able to comprehend any glimpses of God in nature.

As Torrance points out, Barth did not deny the possibility or the existence of natural theology, but rather held that the claims of natural theology are not self-evident and must always be united with and subordinated to the truth revealed in Jesus Christ. Barth is less concerned with the possibility of natural revelation than he is with exposing the problem of establishing an autonomous natural revelation, independent of the revelation of God in Christ. In Barth's view, an autonomous knowledge of God simply cannot occur, because the possibility of such a knowledge is found only in God's own self and is revealed to those God chooses.[50]

Torrance moderates Barth's polemic somewhat by finding a place for some correlation between God's self-revelation and the natural world. He enriches Barth's christology by developing the underdeveloped notion of *Christus Creator* as *logos asarkos*.[51] The divine creation of the world through Jesus Christ as *logos* (John 1) implies a contingent rational ordering of the universe.

Since there is an ontological identity between Jesus Christ as *logos* in creation and as the Son and Word of God in the person of Jesus of Nazareth, Torrance argues that that there is a profound consonance between the intelligibilities of divine revelation and of the created universe.[52] Without taking that consonance into account, Christian theologians cannot offer a faithful account of knowledge of God as God has actually made the divine self known. For Torrance, Christian theology functions analogously with the natural sciences, in that it is responsive to its object and is faithful to the line of inquiry that the object demands.

The concept of contingency is central to Torrance's strategy for interpreting the "Book of Nature." Modern science was not able to emerge until the theoretical foundations were laid for scientists to believe that the material world was intelligible in contingent relations.[53] Modern science is built on the assumptions of contingency and contingent order.[54] Torrance writes:

> [Contingency becomes] the common ground that Christian theology, in dialogue with natural science, needs to re-examine and clarify the notion of creation, and that natural science, in dialogue with Christian theology, can derive help for its own difficult task as it pushes its investigations to the very boundaries of being, to the very perimeter of the creation of matter and form, where natural scientific modes and formalizations of thought reach their limit.[55]

Torrance accepts that a natural theology has a significant place within Christian theology, in the light of an understanding of the nature of God and the world that rests on divine revelation, and that cannot itself be ascertained by human inquiry. His argument that natural theology has a role within systematic theology parallels Einstein's employment of geometry in physics.[56] When conducted under the rubric of Christian positive theology, Torrance says:

> [Natural science] becomes 'natural' in a new way, natural to its proper object, God in self-revealing interaction with us in space and time. Natural theology, then constitutes the epistemological geometry, as it were, within the fabric of revealed theology.[57]

To call theology "epistemological geometry" demonstrates the intellectual and methodological continuity that Torrance sees between the two disciplines. A proper theological perspective on nature allows it to be seen in its proper light. Torrance's restoration of a qualified natural theology within the Calvinist framework of revealed theology is better labeled as a theology of nature. He is not attempting a pre-Christian systematic analysis of religious experience and understanding, but rather challenges the acceptance of a post-resurrection incorporation of scientific study into a doctrine of creation.

Torrance's decisive modification of Barth's position at this critical juncture constitutes one of his most significant contributions to the discussion of the relation between science and religion, and opens the way to a genuine and significant dialogue between natural and special knowledge of God revealed in the "Two Books." Torrance's theology of nature provides a framework through which one can synthesize theological and scientific knowledge, to include the cosmos as well as humanity in a genuine theology of the Word of God.

Torrance's re-appropriation of the ancient notion of "Two Books" should be actively continued in contemporary Protestant theology today. Faithful to the Reformed tradition, Torrance facilitates constructive dialogue with the scientific disciplines by acknowledging nature as a book through which God also discloses the divine self. A judicious use of "Two Books" theory has positive implications for a more interdisciplinary Protestant theological method.

V. Toward a hermeneutics of nature: a constructive proposal

In this final section, I sketch out some of the critical issues that remain for Torrance's program to come to fruition. I choose the heading "hermeneutics of nature" instead of theology or philosophy because I see the Protestant theological project as fundamentally a hermeneutical enterprise. Other theologians have used a similar strategy, including Alan J. Torrance's discussion of "hermeneutics of creation"[58] and Christian Link's discussion of "*Die Interpretation der Natur.*"[59]

"Word of God" theology is the best way to describe the project of the magisterial reformers. With the *Sola Scriptura* slogan and the strong polemic against tradition, Calvin and Luther began a modern trajectory of vigorous scriptural interpretation and hermeneutical debate. With critiques of religion and higher critical methods of studying the scriptures, interpretation of the biblical literature became radically reconceived in the eighteenth and nineteenth centuries, subverting much of the religious power of these sacred narratives.[60] Although both liberals and conservatives employ similar forms of historical-critical interpretation, the assumptions about biblical authority are often disparate.

> ***Torrance's theology of nature allows for the affirmation of a universal scientific method on the one hand, and the particularity of theology on the other, avoiding the potential weaknesses of Barth's approach while maintaining the uniqueness of theology as an intellectual discipline.***

Protestant liberalism has, by and large, relinquished the normative authority of the Scripture and compensated by developing interesting naturalist constructive theologies,[61] while conservatives have maintained biblical authority, but have not been able to write systematic theology in a truly interdisciplinary and ecologically sensitive way.[62] At extremes, the emphasis is on the "Book of Nature" for the liberals, be it human nature and/or the natural world, while for conservatives, it is the "Book of Scripture." By reclaiming the "Two Books" theory from Calvin, Torrance calls conservatives to move out from their christocentric, biblical foundation, to engage in active, self-critical dialogue with the natural and social sciences. At the same time, he calls the liberals to re-engage the biblical narratives that record salvation history, as an increasing number of post-liberals are doing.[63]

The question still remains as to how the "Book of Nature" and the "Book of Scripture" should be related. To be true to the Calvinist tradition, theologians and scientists in the Reformed tradition must always interpret the "Book of Nature" through scripture. Calvin discussed the biblical revelation as a pair of spectacles through which humanity learns how to see nature for what it really is. According to the Reformed tradition, the recovery of the "Book of Nature" as a source of theology must be interpreted through the revelation of God in Christ, disclosed in salvation history as narrated in the biblical literature. To depart from this christo-biblical mode of discourse is to depart from the primary normativity of the biblical literature in historic orthodox Protestantism. Thus, a central hermeneutical principal is that the "Book of Scripture" has primary normative authority (*norma normans*), while the insights gained from the "Book of Nature" have secondary normativity.

The "Book of Scripture" as the norming norm should be brought into dialectical conversation with the "book of nature," shaping the understandings of the latter. Hans-Georg

Gadamer provides helpful categories for analyzing this process of interpretation. Coming to the scriptural text with a pre-understanding and *Wirkungsgeschichte*, we are grabbed by both the text of scripture and the text of nature, and we broaden our horizons through an interdisciplinary pursuit of understanding. Understanding is achieved through a fusion between the biblical horizon and the contemporary horizon of the human and natural sciences. The Christian theological challenge is to evaluate constantly the development in understanding, employing the norm of scripture. Thus, rigorous exegetical study becomes a primary intellectual habit for the Christian theologian cultivating *phronesis*, which is achieved through experience and education (*Bildung*) and enables the theologian to make sound interpretive judgments.

This dialectical model allows for growth in understanding and provides theology with a public space wherein truth claims can be critically discussed and verified.[64] It preserves the authoritative status of the traditional sources of theology, while being open to insights from other disciplines to enhance and implement the project of systematic theology. Is it possible to maintain faithfulness to the authoritative texts, pronouncements, and dogmas of the particular Christian Church communions, while relating and integrating them with definitive findings in the social and natural sciences? Christian systematic theologians, be they Catholic, Orthodox, Anglican, or Protestant, have no choice but to do so.

Renewing the doctrine of creation in the Protestant tradition holds promise in a plethora of areas. I will mention only four: (a) theology and science, (b) public policy and ecological praxis, (c) liturgy and the arts, and (d) *creatio nova* and eschatology. Firstly, the doctrine of creation provides a Christian theological basis for substantive scholarly exchange between theology and science in our contemporary technological culture. For example, the panentheistic strategy for interpreting God's action in nature needs to be evaluated in more detail from scientific and theological perspectives.[65] Secondly, because of the goodness of creation and humanity's creation mandate, as stewards of the earth and economy, Christians should begin to think more deeply about their public responsibilities as citizens, including their ecological praxis. Thirdly, Protestants would do well to recover the liturgical and sacramental understanding of creation of St. Basil, preserved in Roman Catholic and Eastern Orthodox thought and practice, renewing their understanding of the literary and visual arts. Finally, Christian theologians need to follow the lead of Moltmann and Pannenberg in viewing their current discussions and practices through the lens of the coming Kingdom of God, the redemption of humanity, and the restoration of the new heaven and earth.

VI. Conclusion

Developing a "hermeneutics of nature" holds much promise for the future of Protestant theology and the religion and science dialogue. The "Two Books" theory of revelation provides a visual framework to orient the task of writing Christian systematic theology today. Karl Barth emphasized how important it is for Protestant "Word of God" theologians to interpret the "book of nature" through the "book of scripture." His theological heirs, Moltmann, Pannenberg, and Torrance, have been able to provide a new mode of Protestant systematic theology that places redemption within two broader contexts: the cultic-narrative context of salvation history from Creation to Consummation, and the public context of interdisciplinary inquiry. For example, Thomas Torrance's theology of nature allows for the affirmation of a universal scientific method on the one hand (the "Book of Nature" properly construed), and the particularity of theology on the other (the "Book of Scripture" dialectically interpreted), avoiding the potential weaknesses of Barth's approach while maintaining the uniqueness of theology as an intellectual discipline.

The "hermeneutics of nature" holds great promise for the science-and-religion dialogue. In the first place, understanding scientific and religious truth claims in their broadest hermeneutical contexts highlights the theory-laden nature of each intellectual discipline. The idea of science as an interpretive enterprise is much more in keeping with contemporary philosophy of science than the idea that science is a way of uncovering the naked "facts" about the world.[66] Since theorizing is prior to scientific practice, facts can not be separated from their theoretical framework. In theology, too, interpretive traditions play a major role in how doctrines are formulated and understood. The place of tradition within Protestant theological hermeneutics remains a critical question that deserves more historic research and constructive proposal.

The second contribution that this Protestant "hermeneutics of nature" makes to the science-and-religion dialogue is a unique theological argument leading to a common collaborative interdisciplinary pursuit for a deeper understanding of the natural world. Torrance's reformulation of the problem of natural theology is of major importance to the development of a positive relation between theology and the natural sciences. Theology and the natural sciences stand together in their mutual affirmation of the rationality and intelligibility of the world.[67] The epistemological realism of science and theology unites them in a common critique of radical deconstructive and social constructivist theorists. Even though religious and scientific communities may be "imperfect epistemic communities," there is an objectivity to reality, as well as positive advance in scientific and theological study.[68] Since each disciplinary community is bound by epistemic limits, scholars in each need to stay in constant dialogue across disciplinary lines throughout the academy as they seek truth in their respective disciplines.

Holding the "Book of Nature" and the "Book of Scripture" in dialogical communion is a positive theological framework that encourages Protestant theologians to take scientific research seriously. Through the dialogue, scientists are encouraged to explore the motifs of the Christian tradition and the wisdom traditions of other world religions, as various theological, philosophical and ethical questions are raised in the process of scientific practice. As two theory-laden traditions of inquiry,both science and Christian theology are traditions still in process, alive and evolving. Only through learning how to listen to the mutual insights of these two scholarly traditions will they mature together in the interpretation of the "Book of Nature" that is in front of us all, the pages of which we turn—or turn us—every day.

Works cited:

Bacon, Francis. *Advancement of Learning*. G. W. Kitchen, ed. London: Dent, 1973.

von Balthasar, Hans Urs. *The Glory of the Lord: A Theological Aesthetics*. Vol. 1, *Seeing the Form*. Trans. Erasmo Leiva-Merikakis. Ed. Joseph Fessio and John Riches. San Francisco: Ignatius Press, 1982.

Barth, Karl. *Church Dogmatics*, Volumes 1-4. Ed. G.W. Bromiley and T.F. Torrance. Edinburgh: T & T Clark, 1956-1975.

Basil, St. 1995. "The Hexaemeron." In *Letters and Selected Works. Nicene and Post-Nicene Fathers*, vol. 8, 2nd series, ed. by Philip Schaff and Henry Wace, 51-108. Grand Rapids: Wm. B. Eerdmans, 1952.

Berger, Peter. *The Sacred Canopy: Elements of a Sociological Theory of Religion*. Garden City: Doubleday, 1967.

Brooke, J. H. "Natural Law in the Natural Sciences: The Origins of Modern Atheism?" *Science and Christian Belief* 4 (1992): 83-103.

_____. *Science and Religion: Some Historical Perspectives*. Cambridge: Cambridge University Press, 1991.

_____. "Science and Theology in the Enlightenment." In *Religion and Science: History, Method, Dialogue*, ed. by W. Mark

Richardson and Wesley J. Wildman, 7-28. New York: Routledge, 1996.

Brunner, Emil. "On the History of the Doctrine of Creation." In *Dogmatics*, vol. 2, *The Christian Doctrine of Creation and Redemption*, by Emil Brunner, 36-38. London: Lutherworth, 1952.

Buckley, Michael J. *At the Origins of Modern Atheism*. New Haven: Yale University Press, 1987.

Calvin, John. *Institutes of the Christian Religion*. Ed. John T. McNeil. Philadelphia: Westminster, 1955.

Clayton, Philip. *The Problem of God in Modern Thought*. Grand Rapids: Eerdmans, 2000.

_____. *God and Contemporary Science*. Grand Rapids: Eerdmans. 1997.

Davis, John Jefferson. "Ecological 'Blind Spots' in the Structure and Content of Recent Evangelical Systematic Theologies." *JETS* 43/3 (June 2000): 273-86.

Descartes, René. *Meditations on First Philosophy*. Indianapolis: Hackett Publishing Company, 1993.

Emerton, Norma. "The Argument for Design in Early Modern Theology." *Science and Christian Belief* 1 (1989): 129-47.

Frei, Hans W. *The Eclipse of Biblical Narrative*. New Haven: Yale University Press, 1974.

Frye, Ronald M. "The Two Books of God." *Theology Today* 39 (1982): 260-66.

Funkenstein, Amos. *Theology and Scientific Imagination from the Middle Ages to the Seventeenth Century*. Princeton: Princeton University, 1986.

Gadamer, Hans-Georg. *Truth and Method*. New York: Crossroad, 1975.

Henry, Carl F. H. *God, Revelation, and Authority*. Vol. 1-6. Waco, Tex.: Word Books, 1976-1983.

_____. "Science and God's Revelation in Nature." *Bulletin of the Evangelical Theological Society* 3, no. 2 (1960): 25-36.

Hume, David. *Dialogues Concerning Natural Religion*. Indianapolis: Bobbs Merrill, 1779.

Hunsinger, George. "Karl Barth's Christology: Its Basic Chalcedonian Character." In *The Cambridge Companion to Karl Barth*, ed. by John Webster, 127-42. Cambridge: Cambridge University Press, 2000.

_____. *How to Read Karl Barth: The Shape of His Theology*. Oxford: Oxford University, 1991.

Jenson, Robert. *Alpha and Omega: A Study in the Theology of Karl Barth*. New York: Thomas Nelson, 1963.

Kaiser, Christopher B. *Creational Theology and the History of Physical Science: The Creationist Tradition from Basil to Bohr*. Leiden: Brill, 1997.

_____. *Creation and the History of Science*. London: Marshall Pickering, 1991.

Kant, Immanuel. *The Critique of Practical Reason*. 3rd ed. Trans. Lewis White Beck. Upper Saddle River, N.J.: Prentice Hall, 1993.

Kaufman, Gordon. *In Face of Mystery*. Cambridge, Mass.: Harvard University Press, 1993.

Kitcher, Philip. *The Advancement of Science: Science without Legends, Objectivity without Illusions*. Oxford, Oxford University, 1993.

Kuhn, Thomas. *The Structure of Scientific Revolutions*. Chicago: University of Chicago Press, 1962.

Link, Christian. *Schöpfung: Schöpfungstheologie angesichts der Herausforderungen des 20. Jahrhunderts*. Gütersloh, Gütersloher Verlagshaus Gerd Mohn, 1991.

Marion, Jean-Luc. *On Descartes' Metaphysical Prism: The Constitution and the Limits of Onto-theo-logy in Cartesian Thought*. Trans. Jeffrey L. Kosky. Chicago: University of Chicago, 1999.

McGuire, J. E. "Scientific Change: Perspectives and Proposals." In *Introduction to the Philosophy of Science*, ed. by Merrille

Salmon, John Earman, Clarke Glymour, James Lennox, Peter Machamer, J.E. McGuire, John D. Norton, Wesley Salmon, and Kenneth Schaffner, 132-78. Prentice Hall: New York, 1992.

Moltmann, Jürgen. *History and the Triune God*. Trans. John Bowden. New York: Crossroads, 1991.

_____. *God in Creation*. Minneapolis: Fortress, 1983.

Murphy, Nancy. *Beyond Liberalism and Fundamentalism: How Modern and Postmodern Philosophy Set the Theological Agenda*. Valley Forge, Pa.: Trinity, 1996.

Neville, Robert C. "Religious Studies and Theological Studies." *Journal of the American Academy of Religion* 6 (Summer 1993): 185-200.

O'Higgins, J. "Hume and the Deists." *Journal of Theological Studies* 22 (1971): 479-501.

Pannenberg, Wolfhart. "The Doctrine of Creation and Modern Science." *Zygon* 23 (1988): 3-21.

_____. *Theology and the Philosophy of Science*. Trans. Francis McDonagh. Philadelphia: Fortress Press, 1976.

Parker, T. H. L. *Calvin's Doctrine of the Knowledge of God*. Edinburgh: Oliver & Boyd, 1969.

Peacocke, Arthur. "Science and The Future of Theology: Critical Issues." *Zygon* 35 (March 2000): 119-215.

_____. *Theology for a Scientific Age: Being and Becoming Natural and Divine*. Expanded ed. Oxford: Basil Blackwell, 1993.

Popkin, R. H. *The History of Skepticism from Erasmus to Descartes*. New York: Harper Torchbooks, 1968.

Popper, Karl. *The Logic of Scientific Discovery*. New York: Basic Books, 1959.

Santmire, H. Paul. 1966. "Creation and Nature: A Study of the Doctrine of Nature with Special Attention to Karl Barth's Doctrine of Creation." Unpublished Th.D. dissertation. Harvard University, 1966.

Schmemann, Alexander. *For the Life of the World*. Crestwood, N.Y.: SVS Press, 1998.

Schleiermacher, Friedrich. *The Christian Faith*. Eds H. R. Macintosh and J. S. Stewart. Edinburgh: T & T Clark, [1830] 1999.

_____. *On Religion: Speeches to its Cultured Despisers*. Trans. and ed., Richard Crouter. Cambridge: Cambridge University, 1988.

Schreiner, S. E. *The Theatre of His Glory: Nature and the Natural Order in the Thought of John Calvin*. Durham, N.C.: Labyrinth Press, 1991.

Stout, J. *The Flight from Authority*. South Bend, Ind.: Notre Dame University Press, 1981.

Taylor, Charles. *Sources of the Self: The Making of the Modern Identity*. Cambridge, Mass.: Harvard University Press, 1989.

Torrance, Alan J. "Creatio Ex Nihilo and the Spatio-Temporal Dimensions, with Special Reference to Jürgen Moltmann and D.C. Williams." In *The Doctrine of Creation*, ed. by Colin Gunton, 83-104. Edinburgh: T&T Clark, 1997.

Torrance, Thomas F. "Einstein and God." *Reflections: Journal of the Center of Theological Inquiry* 1 (Spring 1998)" 2-15.

_____. "Science and Access to God: Epistemological Perspectives.", *Jian Dao* 10 (1998): 43-58

_____. "The Transcendental Role of Wisdom in Science." In *Facets of Faith and Science*, vol.1, *Historiography and Modes of Interaction*, ed. by Jitse van der Meer, 131-49. New York: Pascal Centre for Advanced Studies in Faith and Science, 1996.

_____. "Realism and Openness in Scientific Inquiry." *Zygon* 23 (1988): 159-69.

_____. *Reality and Scientific Theology: Theology and Science at the Frontiers of Knowledge*. Edinburgh; Scottish Academic Press, 1985.

_____. *Divine and Contingent Order*. Oxford: Oxford University Press, 1981.

_____. *Theology in Reconstruction.* Grand Rapids: Eerdmans, 1966.

Toulmin, Stephen. *Cosmopolis.* New York: Free Press, 1990.

Ware, Kallistos. "Ways of Prayer and Contemplation." In *Christian Spirituality*, ed. by Bernard McGinn and John Meyendorff, 395-414. New York: Crossroad, 1985.

Webster, John and George P. Schner. *Theology After Liberalism.* Oxford: Blackwell, 2000.

Welker, Michael. *Creation and Reality.* Minneapolis: Fortress Press, 1999.

_____. "Is the Autonomous Person of European Modernity a Sustainable Model of Human Personhood?" In *The Human Person in Science and Theology*, ed, by Niels Henrik Gregersen, Willem B. Drees, and Ulf Görman, 96-116. Edinburgh: T & T Clark, 2000..

Wildman, Wesley. "Theological Literacy: Problem and Promise." In *Theological Literacy*, ed. by Rodney Peterson. Boston: Boston Theological Institute, forthcoming 2001.

Endnotes:

1. McGuire, pp. 45-46.

2. Gadamer; Berger; Kuhn; Popper.

3. Frye.

4. Kaiser, *Creation and the History of Science*, p. 61.

5. Ware, p. 398.

6. Basil, 1.7.55.

7. Ibid., 1.7.56.

8. Ibid., 1.6.55.

9. Calvin, 1.2.1.

10. Ibid., 1.5.3.

11. Welker, "Is the Autonomous Person," p. 107.

12. Calvin, I.15.4; II.2.12-17.

13. Ibid., I.5.5-14.

14. Ibid., I.5.14.

15. Welker, *Creation and Reality*, p. 25.

16. Calvin, II.6.

17. Parker.

18. Popkin.

19. Toulmin; Stout.

20. Popkin.

21. Brooke, "Science and Theology," pp. 8, 9; Funkenstein.

22. Brooke, *Science and Religion*, p. 53.

23. Bacon, 1.6.12.

24. Taylor, pp. 143-158; Marion, p. 240.

25. Descartes, p. 17.

26. Descartes, pp. 31-35.

27. Buckley; Brooke, "Natural Law"; Brooke, "Science and Theology."

28. O'Higgins.

29. Kant, p. 169.

30. Schleiermacher, *The Christian Faith*, §15:76; §4:12.

31. Ibid., §39:148.

32. Ibid., §40:151.

33. Ibid., §36-39:142-49.

34. Ibid., §40, 150,151.

35. Ibid., §40, 150.

36. Clayton, *The Problem of God*, pp. 347-83.

37. Ibid., p. 383.

38. Emil Brunner argues this tendency to "monergism" was latent in the thought of the Reformers (p. 37). He quotes Calvin's statement in the *Institutes*: "I admit that the expression, 'Nature is God', may be piously used, if dictated by a pious mind." (Calvin, I.5.5).

39. Kaiser, p. 353.

40. Hunsinger, *How to Read Karl Barth*, pp. 255-56.

41. See, e.g., Barth, II/2:89; cf. Jenson, p. 18, n.5.

42. Barth, III/1:44.

43. Hunsinger, "Karl Barth's Christology," p. 128.

44. Moltmann, *History and the Triune God*, pp. 125-42.

45. Santmire, abstract.

46. Barth, III/1:ix,x.

47. Neville.

48. Pannenberg, "The Doctrine of Creation," and *Theology and the Philosophy of Science*.

49. Thomas Torrance, *Reality and Scientific Theology*.

50. Barth, II.1:63.

51. Thomas Torrance, *Theology in Reconstruction*, pp. 33ff.

52. Thomas Torrance, "The Transcendent Role."

53. Thomas Torrance, *Divine and Contingent Order*, pp. 33ff.

54. Ibid, p. ix.

55. Ibid.

56. Thomas Torrance, "Einstein and God," pp. 2-15.

57. Thomas Torrance, *Reality and Scientific Theology*, p. 39.

58. Alan Torrence, pp. 99-100.

59. Link, pp. 476ff.

60. Frei.

61. See, e.g., Kaufman.

62. See, e.g., Henry, *God, Revelation, and Authority*, and "Science and God's Revelation in Nature"; cf. Davis.

63. Cf. Murphy; Webster and Schner.

64. Peacocke, *Science and the Future of Theology*; Wildman, "Theological Literacy."

65. See, e.g., Moltmann, *God in Creation*; Peacocke, *Theology for a Scientific Age*; Clayton, *God and Contemporary Science*.

66. McGuire, pp. 145-46.

67. Thomas Torrance, "Realism and Openness."

68. Kitcher, pp. 303-89.

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Difference within Theology of Nature: The Strategies of Intelligibility and Credibility

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This author examines and augments a particular aspect of Ian Barbour's well-known four-fold typology for relating religion and science (conflict, independence, dialogue, and integration) in order to clarify two options available for theology as it develops a robust view of creation in conversation with modern science. Within integration, Barbour identifies several subtypes, including "theology of nature." The Gifford Lectures of Arthur Peacocke and John Polkinghorne provide important examples of theology of nature, yet differences between their approaches remain unexplained within Barbour's typology. An explanation is offered here, showing that Peacocke and Polkinghorne employ two distinct strategies to construct a theology of nature: the strategy of intelligibility and the strategy of credibility. After characterizing these strategies, the author suggests that at present the relationship between them takes the form of a dilemma.

> Theology has to do, not with natural objects, but with states and movements of man's spiritual life.
> –Albrecht Ritschl, 1888[1]

> The turbulent history of the relation of science and theology bears witness to the impossibility of theology seeking a peaceful haven, protected from the science of its times...
> –Arthur Peacocke, 1993[2]

> What I want to know is whether the strange and exciting claims of orthodox Christianity are tenable in a scientific age.
> –John Polkinghorne, 1996[3]

Introduction

As part of the theological legacy of Isaac Newton and Immanuel Kant, the question of whether scientific knowledge of the physical world should inform theological reflection has received a great deal of attention by Protestant theologians in the last two centuries.[4] During the nineteenth century, a dominant approach, especially among liberal Protestants such as Ritschl, sought to retain the integrity of human experience over and against a mechanistic world by distinguishing between the realm of nature and the realm of spirit, the latter of which was taken as humanity's true context.[5] The human person was elevated above the realm of natural law and thus freed from the confines of physical processes. Persons were not to be thought of as objects belonging to the world of nature but rather, to put it in Ritschlian terms, as citizens of the Kingdom of God.

By ignoring the rootedness of human life in the physical matrix of the world, theological accounts of humanity such as Ritschl's unfortunately, if understandably, provided an incomplete, fractured view of creation.[6] The legacy of this kind of view remains today in the widespread neglect of strategies for establishing connections between theological claims and related claims from other disciplines, especially the sciences. Theology has tended to react to science's mechanistic view of the world by creating a world of its own, a theological safe haven for reflection and retreat.[7] However, the cost of this isolationist strategy has not gone unnoticed.

In recent decades, a growing number of theologians have seen the need to engage contemporary science in new ways rather than uncritically perpetuate reactions to an outdated, mechanistic understanding of the world. In response to the story told by twentieth-century science of the openness, novelty, and creativity inherent in the physical world, and of the intricate links between the natural world and human life, theologians are returning to such biblical themes as the unity of the person and the significance of all creation within God's purposes.[8] There is a growing sense that the question for theology is not *whether* it ought to engage the sciences, but *how* it should do so.

Among those who have led the call for a reassessment of theological doctrine in light of contemporary scientific knowledge are scientist-turned-theologians Arthur Peacocke and John Polkinghorne. Most notably in their Gifford Lectures, *Theology for a Scientific Age* and *Faith of a Physicist*, respectively, these two authors have embraced the task of recasting theology in light of scientific knowledge; and both have done so without either wantonly abandoning traditional theological claims or unduly submitting to the bare philosophical materialism erroneously trumpeted by some present-day apologists as the logical entailment of modern science. As masters of their respective scientific fields, biochemistry and physics, Peacocke and Polkinghorne have helped numerous theologians and pastors come to a more integrated and nuanced view of the physical world through their scientifically informed theological writings.

While each of these authors acknowledges a certain affinity between his work and natural theology's traditional attempt to prove the existence of God through reason and experience, their theological interests lie not in using science to prove God but rather in integrating a wide range of theological and scientific claims.[9] In taking on this broader task, Polkinghorne and Peacocke have each adopted particular strategies for establishing connections between theology and science. This paper identifies the distinctiveness of their strategies as well as the implications of these strategies for the theology-and-science dialogue.

A good place to begin talking about different strategies to relate theology and science is Ian Barbour's well-known four-fold typology, which he developed in his influential work *Religion in an Age of Science*. Here he presents a careful and detailed overview of four approaches to relating theology and science—conflict, independence, dialogue, and integration.[10] With regard to integration, the view I adopt and develop here, Barbour identifies several approaches or sub-views, one of which he calls "theology of nature." (See figure 1 at the end of this section for the various sub-views Barbour identifies within each of his four main views.) In this paper, I propose to add a further layer to Barbour's typology by arguing for the thesis that although Peacocke and Polkinghorne each work within the integration view to develop a "theology of nature" in their Gifford Lectures, they do so by employing two distinct strategies: the strategy of *intelligibility* (Peacocke) and the strategy of *credibility* (Polkinghorne).[11] Thus, although I find the term "theology of nature" an apt characterization of the common approach found in Peacocke and Polkinghorne, this paper focuses on several important differences between their approaches—over issues such as the Virgin Birth and the Empty Tomb—differences which Barbour's typology, helpful though it is, cannot explain.[12] As a means of differentiating within the term "theology of nature," the categories *intelligibility* and *credibility* clarify some of the challenges and options for theology as it seeks to take account of contemporary scientific knowledge.[13]

I begin the argument by presenting the merits of "theology of nature" in light of Barbour's identification and comparison of this and two other approaches to integration: theology of nature, natural theology, and systematic synthesis. In the second section, I establish that Peacocke and Polkinghorne both intend to develop a theology of nature in line with Barbour's use of the term. In the third and central section I present the strategies of intelligibility and credibility as characterizations of Peacocke and Polkinghorne's approaches. Here I argue that although both strategies are loyal to theology of nature's general concerns, each nonetheless advances a distinct mode of reasoning. In the fourth section I offer a preliminary assessment of the relationship between these two strategies. Given the virtues and risks associated with each strategy, I characterize the relationship between them as an unresolved dilemma for theology of nature.

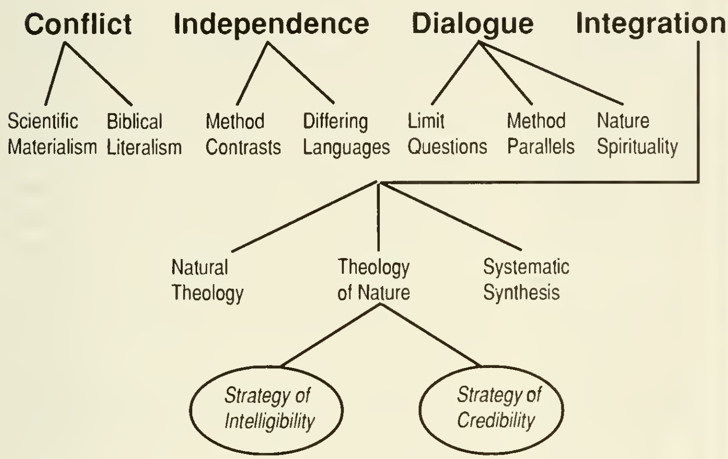

Figure 1. Barbour's typology for relating science and religion with subcategories. The strategies developed in this essay, *intelligibility* and *credibility*, function as subcategories within "theology of nature."

I. Integration with integrity

What does it mean to integrate theological and scientific claims, and what are the different possibilities for achieving integration? In his typology, Barbour identifies integration with the aim of developing direct relationships between theological doctrines and particular scientific theories.[14] Integration seeks to benefit from insights gained through "dialogue," the third of Barbour's options which focuses on common interests (e.g., the well-being of nature) and methods (e.g., the central role of inter-subjectivity in securing knowledge). However, integration goes beyond dialogue in pursuit of systematic links between theology and science. Barbour identifies three approaches to integration.

In the first approach, "natural theology," science comes to theology's aid by describing the intricacies of natural processes such as the development and structure of the cosmos given by the Big Bang cosmological scenario. Here the focus rests primarily on establishing evidence for God's existence. Darwin's theory of biological evolution dealt a serious blow to natural theology in the nineteenth century by arguing that design in nature, which had previously been taken as straightforward evidence of God's handiwork in the world, was instead the result of undirected natural processes merely masquerading as design—the so-called "apparent" design of nature. Since Darwin, natural theologians have largely abandoned arguments from structural complexity and have turned instead to the striking properties of various forms of matter and their associated scientific laws, such as the importance of the proton/neutron mass difference for the development of biological life, which theologians suggest point to the existence of a designing mind behind the order of the universe (the so-called fine-tuning of the universe).[15] Whether by appeal to design or fine-tuning, Barbour rightly judges that natural theology is of limited value to the theological enterprise because it leaves a host of important theological considerations untouched: the human experience of reorientation and transcendence, the movement from brokenness to healing, and the sense of new relationship with God and the world.[16] By considering only those aspects of reality strictly describable within the limited scope of scientific investigation, natural theology's narrow consideration of the issue of God's existence makes for a poor introduction to the more complex aspects of reality such as religious experience and historical revelation.

Another possibility Barbour identifies for theology as it turns an ear toward science is "systematic synthesis." As the term suggests, this approach integrates scientific and theological ideas into a more inclusive metaphysical system. The approach of systematic synthesis relies on a particular metaphysics (Barbour prefers process philosophy) to provide a common set of general categories for integrating theology and science into a more coherent vision of reality. One danger inherent in this approach mentioned by Barbour is the distortion that can result from mapping the variety and complexity of human experience onto an overly neat intellectual system.[17] In such cases, for example, the horror of human suffering often tends to be trivialized through the very act of explanation and categorization. Equally serious, theology risks being made into an example of a more general philosophical position. Whereas natural theology begins with science as it struggles to move from God's existence to God's characteristics and purposes, systematic synthesis starts with theology but risks giving philosophy the last word. Both approaches jeopardize the integrity of theology by making theology less than an equal participant in the conversation with science and the quest for understanding.

Barbour uses the term "theology of nature" to designate the approach that strives to preserve theology's disciplinary integrity while attaining genuine interaction with science. He defines theology of nature as "critical reflection, within a tradition based on historical revelation and religious experience, in which theological beliefs concerning nature are reformulated in the light of contemporary science."[18] The only dissatisfaction I have with Barbour's definition stems from his restricting the range of relevant theological beliefs to those "concerning nature" alone. Barbour's *Religion and Science* puts forward a significantly more ambitious agenda than simply a revised doctrine of the natural world (and rightly so, given the interconnected character of theological thought), which leads me to propose the following modification to Barbour's definition: theology of nature is critical reflection, within a tradition based on historical revelation and religious experience, in which the *entire scope of theology* is up for consideration and reformulation in light of contemporary science. This broadened definition of theology of nature, which I assume below, goes beyond a reconsideration of the place of "nature" in theology to include more general issues regarding the task of theology in light of scientific knowledge. Taken in this revised and expanded form, theology of nature becomes a legitimate and appropriate alternative to natural theology and systematic synthesis.[19] Moreover, theology of nature brings into the discourse of theology the epistemological consideration of theology's relation to other disciplines and modes of knowledge, a topic which has often been ignored or viewed as preliminary to the theological task.

Theology of nature, unlike natural theology, brings a "full wealth of conviction" to the conversation with science, even as it is amenable to being reshaped through a critical engagement with what science has to say about the world.[20] Theology of nature also need not be unappreciative of the clarity that comes with clear philosophical concepts, but it resists being subsumed into a more general philosophical system—it begins not with general categories, but with the particulars of Christian revelation and experience. From this starting point, theology of nature moves outward to engage claims from other disciplines (as well as other religions) about the world. As an approach to integration, theology of nature thus occupies a mediating position between the more scientifically driven approach of natural theology and the more philosophically oriented approach of systematic synthesis. This approach is, thus, well suited to the task of engaging science while maintaining the integrity of theological claims. Having put forward this understanding, I turn now to Peacocke's and Polkinghorne's Gifford Lectures and argue that both merit the designation, "theology of nature."

II. Two theologians, one approach

Theology of nature, as Barbour has developed it and I have presented it above, suggests five broad themes or concerns that shape the underlying structure of a scientifically informed theology. These relate to (1) scientific methods, (2) scientific accounts of the world, (3) views of reality, (4) the God-world relationship, and (5) the integrity of creation. In this section, I develop these five themes and show that they do, in fact, characterize the basic thrust of the proposals put forward by Peacocke and Polkinghorne in their respective Gifford Lectures. In the section following this one, I will revisit each theme, but with the opposite task of highlighting several important differences between Peacocke and Polkinghorne's work—differences that I will explain in terms of the strategies of intelligibility and credibility.

The first integral theme for theology of nature is *a detailed investigation of scientific methods that does not assume theology must adopt a thoroughly "scientific" mien.* On the one hand, theology of nature is eager to understand the means by which science so successfully garners knowledge of certain aspects of reality and to discern ways in which it can learn from science's success. This desire on theology's part to engage other ways of knowing has been encouraged in recent decades by the ongoing discussion within the philosophy of science about the limits as well as the informal character of the scientific method.[21] On the other hand, theology of nature will resist a scientistic attitude (latent in some versions of natural theology) that takes science to be the only sure way to knowledge. Openness to methodological insights from science need not result in theology relinquishing the methodological wisdom of its own heritage. According to Polkinghorne, such an approach attempts "to do justice to the idiosyncracy of the discipline [of theology], while at the same time assimilating it to many other forms of human rational inquiry, including science"; in Peacocke's words, theology "needs to be consonant and coherent with, though far from being derived from, scientific perspectives on the world."[22] Theology of nature will also resist ceding too much control to any philosophical system, although it gratefully acknowledges any conceptual clarity philosophy has to offer regarding specific concepts or issues. Both Peacocke and Polkinghorne endorse this attitude toward philosophy and draw a firm distinction between philosophical theism's abstract conception of God and the Christian doctrine of God grounded in the life, death, and resurrection of Jesus Christ. Theology of nature brings to the discussion the full particularity and wealth of its methods and claims even when, through the course of discussion, it becomes clear that certain doctrines must be reformulated or even abandoned.

By considering only those aspects of reality strictly describable within the limited scope of scientific investigation, natural theology's narrow consideration of the issue of God's existence makes for a poor introduction to the more complex aspects of reality such as religious experience and historical revelation.

The incorporation of scientific accounts of the world into theology by engaging science's best-established concepts and theories constitutes the second integral theme for theology of nature. At this level, theology's desire to expose itself to science moves beyond the realm of method and into the realm of scientific theory and theological doctrine. Peacocke expresses the task as follows:

> ...to evolve a theology that has been refined...in the fires of the new perceptions of the world that the natural sciences have irreversibly established.[23]

Polkinghorne, too, articulates his desire for more than peripheral contact when he says:

> I am convinced that the discussion must not just be on the frontier between science and theology, but must penetrate as deeply as possible into their heartlands.[24]

From Big Bang cosmology and evolutionary biology to cognitive neuroscience and genetics, theology of nature takes stock of the full range of recent scientific developments and discoveries when reconsidering the content and relations of the doctrines of God, creation, anthropology, evil, incarnation, salvation, eschatology—indeed, the entire theological agenda.[25]

The articulation of a rich, differentiated view of reality which simultaneously avoids a dualist view of creation marks the third integral theme for theology of nature. Here, theology takes its stand against reductionist views of the world which aim to strip the human spirit and human experience of their causal powers by labeling them as mere epiphenomena riding on top of what are taken to be the actual ontological and causal structures of reality (subatomic particles, fields, and the like), as well as against dualist views which attempt to preserve the causal and theological integrity of human experience by positing a realm of reality, the realm of the spirit, which is separate from the physical world. Charting a course between reductionism and dualism, theology of nature brings to the table its own "data" about the world—what Peacocke calls a tradition's "accumulated wisdom"[26]—including the notion and content of revelation. Given the amount of space Peacocke and Polkinghorne devote to discrediting reductionism, one could fairly say they count it among theology's most pressing tasks. Polkinghorne devotes the entire first chapter of *Faith of a Physicist*, entitled "Humanity," to developing a view of reality which makes room for mind and spirit as actors in the world, thus setting the stage for subsequent theological discussion. Polkinghorne's term for his own view, "dual-aspect monism," denotes a unified creation which is nonetheless differentiated into two states or phases, the material and the mental. Peacocke makes a somewhat different argument against reductionist claims (more on the difference later), but with similar intentions. He develops a multi-layered view of reality, arguing as follows:

> [T]here is no sense in which subatomic particles are to be graded as 'more real' than, say, a bacterial cell or a human person or a social fact.[27]

The richly differentiated human experience of reality, in other words, is a key to the way the world really is. To use Polkinghorne's expression, "epistemology models ontology."[28] Or as Peacocke puts it, there are good grounds for "believing that what is real is what the various levels of [our] description [of reality] actually refer to."[29] For both Peacocke and Polkinghorne, the nonreducibility of the levels of description we employ implies the impossibility of reducing reality to the constituents of any particular level. Instead, reality must be richly differentiated. At the same time, both affirm the biblical view of the psychosomatic unity of the person and assert that theology must reshape its concept of personhood in accordance with the view that persons are entirely part of the physical world, even though experiences of transcendence are a defining feature of human life.[30]

As an approach to integration, theology of nature occupies a mediating position between the more scientifically driven approach of natural theology and the more philosophically oriented approach of systematic synthesis. This approach is, thus, well suited to the task of engaging science while maintaining the integrity of theological claims.

The fourth theme central to theology of nature involves *embracing the idea of God's experiencing and suffering with creation in light of the profoundly temporal character of the universe unveiled by contemporary science.* As Barbour indicates, our growing appreciation of the genuinely changing world around us cannot but shape theology because "our understanding of the general characteristics of nature will affect our models of God's relation to nature."[31] Peacocke and Polkinghorne both respond to the contemporary scientific account of novelty in the world, with its intricate mixture of chance and law, by rethinking the relationship of God to the world in strikingly temporal terms. For each author, God's intimate involvement with the world demands a radical reassertion of divine temporality, even to the point of limiting divine knowledge of the future in light of the world's thoroughgoing temporal character.[32] Each draws on the idea of God's self-limitation as a way of understanding not only the world's existence but also its (limited) ability to "make itself." Furthermore, each uses the notion of God's temporal experience of the world as a stepping stone to discuss what is arguably a defining interest of late twentieth-century theology: the suffering of God in and with the world.[33] If God is temporal, then God shares in the experience of the world, including experiences of suffering. A temporal God suffers with a suffering creation. Polkinghorne develops this idea by arguing for the compatibility of divine suffering with divine power. He sees in God's choice to suffer the basis of hope for the world's future through the redemption of suffering itself.[34]

The affirmation of the integrity of the entire universe in relation to God's purposes constitutes theology of nature's fifth integral theme. The cosmos, this theme affirms, is God's creation. Barbour clearly expresses how crucial it is for theology of nature to redeem and replace the destructive legacy of the traditional, anthropocentric model of human domination over the rest of creation with a more positive view that values the physical world beyond its utility for human purposes. Along with the biblical theme of the stewardship of nature, Barbour advocates a strongly sacramental view in which God is present in and under all creation.[35] It is important to highlight what this theme implicitly affirms, namely, that when theological references are made to the "world" as God's creation, the scope must be broadened to include not only Earth but the solar system, the galaxy, and even the entire universe. Theologians must unlearn "world" and "Earth" as synonyms. Evolutionary biology, astronomy, and cosmology all point to the dynamic and evolving character of the universe, reminding us that the universe as a whole is rightly viewed as God's ongoing creation. In his discussion of revelation, Peacocke argues that what we experience as God's revelation is only a particularly intense form of God's presence which exists at all times and all places in the universe.[36] He sees the incarnation as a disclosure of the general meaning and "consummation of the creative and creating evolutionary process" as a whole.[37] Theology, for Peacocke, should therefore be "regarded as an exploration of the ultimate meaning of all levels," which comes into focus in the Christ-event.[38] Similarly, Polkinghorne uses his dual-aspect monistic view of the universe to guard against the idea that God was less involved in creation prior to the emergence of conscious beings.[39] He concurs with Barbour's view that science can help us learn to value the world apart from its utility for our purposes, and when he declares that "the destiny of humanity and the destiny of the universe are together to find their fulfilment in a liberation from decay and futility,"[40] he echoes Paul's view in Romans 8.

These five themes provide theology of nature with its basic shape. They encourage theological consideration of scientific methods as well as concepts and theories. Even more fundamentally, they promote a reassessment of the entire spectrum of theological considerations in light of science. From this examination of Peacocke and Polkinghorne, both can be seen to engage the methods and theories of science as they develop their theological proposals. Each takes an integrative view of theology's task vis-à-vis science and brings to this task concerns which distinguish theology of nature from Barbour's other integrationist approaches. Having identified Peacocke and Polkinghorne's common approach under the banner "theology of nature," I now turn to several important differences in their work which are not explained by this shared approach.

III. One approach, two strategies

It is my central claim in this paper that the strategies of *intelligibility* and *credibility* represent two strikingly different strategies for crafting a theology of nature. As such, they stand in close conceptual proximity to one another. The terms might, at first glance, even appear indistinguishable. With the help of Peacocke and Polkinghorne, however, each strategy can be seen to give unique emphasis to the key themes developed in the previous section. First, I need to present definitions of these two strategies.

The strategy of intelligibility develops a theology of nature *by placing scientific accounts of the world in an overall context through an appeal to relevant theological concepts, thereby extending the meaning of these scientific accounts to the most comprehensive level.* Intelligibility, in this sense, involves making the broadest possible sense of experience.[41] As a strategy, it aims for more than merely a notional understanding of the world as a purposeful unity. According to Peacocke,

> [The scientific quest for] intelligibility concerning the nature and origin of the cosmos has plunged human beings... into the darker stream of the search for meaning.[42]

The strategy of intelligibility endeavors to offer a deep, satisfying account of the meaning and purpose of the world and humanity as God's creation. In order to give meaning to human experience, this strategy employs a theological framework to support and contextualize scientific descriptions of the world's processes and structures. Accordingly, the strategy begins with scientific accounts of the world and shifts to theological interpretation via questions raised by science but which remain unanswerable within science itself: so-called "limit questions." The strategy of intelligibility, in short, appeals to theology to render the world intelligible. It is important to note that this strategy is radically different from natural theology's strategy of using the world to render God probable. This crucial difference makes intelligibility an important strategy for theology of nature.

In contrast to intelligibility, the strategy of credibility develops a theology of nature *by establishing the tenability of theological claims in light of what science shows us about the breadth, depth, and limits of human rationality.* Credibility, understood in this way, involves establishing resources for rationally motivated belief. This strategy primarily draws from science's account of the world a picture of human rationality which allows for, even validates, theological claims and styles of argumentation. In Polkinghorne's words, the strategy of credibility presents an explanation (i. e., warrant or motivation) for religious belief

> ...comparable to the kind of explanation one might offer of one's conviction that matter is composed of quarks and gluons and electrons.[43]

When theological references are made to the "world" as God's creation, the scope must be broadened to include not only Earth but the solar system, the galaxy, even the entire universe. Theologians must unlearn "world" and "Earth" as synonyms.

It is not that Polkinghorne lacks interest in science's actual account of the world—far from it—but rather that he finds equally interesting, even more illuminating, the epistemological lessons science offers regarding the "how" and "why" of our beliefs about God and Creation. The strategy of credibility, in short, appeals to science to render God credible. As a strategy, it too differs markedly from that of natural theology. Instead of setting its sights on proving the existence of God, it endeavors to motivate, deepen, secure, and inevitably refine existing belief in God in light of what is known about how the world has come to be apprehended through science.

Theology of nature has (at least) these two strategies available to it: (1) to employ theology to extend the intelligibility of world as we know it through science, and (2) to employ the epistemological lessons of science to strengthen the credibility of theological claims about God, humanity, and the cosmos. With these definitions in hand, the differences between Peacocke and Polkinghorne begin to appear more clearly. A quick review of the epigraphs at the beginning of this paper will perhaps now yield not only a sense of the distance between Ritschl's concerns and those of Peacocke and Polkinghorne, but also an increased appreciation for the differences between a theology that intends to make "the science of its times" intelligible and one that intends to establish the credibility of the "strange and exciting" claims of theology in light of science. Several specific examples of Peacocke and Polkinghorne's implementation of these strategies paralleling the themes of the previous section will help to shed further light on their differences.

Peacocke and Polkinghorne have similar views of the way science works—both are influenced by (and express similar reservations about more constructivist versions of) recent work in the philosophy and history of science—and yet each casts the methodological import of science in strikingly different language. For Peacocke, "theology, like any other human inquiry into the nature of reality, must use the same general criteria of reasonableness as, say, science itself."[44] Among the criteria he lists are: fit with data, internal coherence, comprehensiveness, cogency, simplicity, fruitfulness, and (for theology) giving meaning for personal existence. Theology, says Peacocke, "cannot avoid running the gauntlet of these criteria of reasonablness..." [45] His is by no means a positivist view of science, and yet he insists that theology strictly adhere to a set of general criteria in order to contribute to the quest for intelligibility.[46] Polkinghorne, on the other hand, focuses on the richness of human rationality by pointing repeatedly to parallels and analogies between scientific and theological methods regarding issues such as the role of unique events in advancing knowledge, the necessity of complementarity as a tool for describing reality, the place of dynamism in the being of God and creation, the difficulty of theory choice in the absence of crucial experiments, and the need for "corrigible boldness" in both cosmology and New Testament studies.[47] Although one might think Polkinghorne's professed "bottom-up" scientific approach to theology would be compatible with Peacocke's concern to establish general criteria of reasonableness, Polkinghorne is in fact more concerned to ensure continuous contact between theology and the details of human experience than he is to confine theology inside any sharply defined methodological boundary.[48] Thus, while the strategy of intelligibility is to demand that theology meet various general criteria of rationality, the strategy of credibility is to develop a view of rationality rich enough to encompass theological patterns of thought and broad enough to reveal parallels between theological and scientific modes of reasoning.

Peacocke and Polkinghorne are notably divided over the implications of scientific knowledge concerning biological reproduction for the theological issue of the Virgin Birth, or more precisely stated, the issue of Jesus' virginal conception. According to Peacocke, for Jesus to have been "fully human" he must have had a human father. Biological science tells us that without a Y chromosome—which only males can pass on, and which only they inherit—Jesus would not have been born male. Jesus, like all men, must therefore have inherited a Y chromosome from a human father.[49] If theology is to make sense of the special character of the person of Jesus by appealing to the notion of incarnation, Peacocke contends that it will have to do so within the confines of our understanding of biological reproduction. Although Polkinghorne alludes to the difficulty posed by the issues Peacocke raises for a bottom-up thinker like himself, he nonetheless defends the Virgin Birth on the basis of scriptural considerations together with the "symbolic appropriateness of the fusion of divine initiative and human co-operation."[50] Thus, although both authors acknowledge the relevant scientific issues, Peacocke insists that if theology is to contribute to the intelligibility of the Virgin Birth, it must play the hand it has been dealt by science, while Polkinghorne defends the credibility of the narrative, even though it appears to be a biological impossibility.

In spite of the fact that both Peacocke and Polkinghorne articulate a rich, differentiated view of reality, they have strikingly different views of the human person, which reflect their different theological strategies as much as their commonly held anti-reductionist convictions. Peacocke, for instance, develops a detailed hierarchy of reality (with corresponding sciences) as part of his argument against a dualistic view of the human person and for a view of the person as a "microcosm" of the multi-leveled, but thoroughly physical, "macrocosm."[51] Peacocke's claim that human beings are made of the very stuff of the world undergirds his idea that God's interaction with humanity is only a more intense form of God's interaction with the world in general.[52] Polkinghorne, on the other hand, is more concerned to construct a metaphysical view that includes from the outset realities such as mentality and free will. His own "ample and many-valued view of human nature" builds on his discussion of the ideas of complementarity and openness, which, he argues, point to a world of becoming in which "there are opportunities for the action of causal principles, other than the merely mechanical interaction of parts."[53] Whereas Peacocke presumes the sufficiency of known natural processes to explain personhood, Polkinghorne suggests a degree of novelty and receptivity in nature beyond what science can presently describe. By appealing to processes not within the reach of current science, Polkinghorne argues for the credibility of a more traditional theological anthropology on the basis of the continual advance (and abandonment) of scientific theories. Peacocke, on the other hand, takes the best available science as a relatively adequate account of persons within which theology must operate as it attempts to make the concept of personhood intelligible.

A key point of difference between Peacocke and Polkinghorne lies in their estimation of God's relation to the world. Peacocke argues for a panentheistic view:

> [T]he processes revealed by the sciences are in themselves God acting as Creator. . . God is not to be found as some kind of *additional* factor added on to the processes of the world.[54]

God, in Peacocke's panentheistic view, is (but is not limited to) the world considered at its most comprehensive level. Because God *is* natural processes acting in themselves, these processes are rendered amenable to meaning and purpose; that is, they can be made *intelligible*. By contrast, Polkinghorne describes the relation between God and the world in more traditionally theistic terms. Although he accepts a kind of eschatological panentheism, he calls the regularities of nature at best a "pale reflection of the faithfulness of the Creator" and is unsatisfied with Peacocke's equating natural processes with God's action.[55] Instead, he prefers to reshape the traditional view of divine action by interpreting novelty and change in nature as a consequence of God's allowing creation to be itself. Rather than making natural processes intelligible by equating them with God's action, Polkinghorne attempts to present a credible version of God fulfilling the divine purposes in the world by blending the idea of God allowing nature to develop under its own integrity with the idea of God working in and through nature's openness.

Perhaps one of the most striking differences between Peacocke and Polkinghorne centers on their disparate views of the relation of the "Empty Tomb" to the resurrection. Given Peacocke's view that theology must conform to the standards of rationality adhered to by science, it is not surprising that he prefers to remain agnostic about the empty tomb, arguing instead for a notion of resurrection that does not dispute the finality of biological death. In light of the loss of continuity that accompanies death, through the decay and dispersal of the body's molecules, Peacocke argues that resurrection should be understood as a re-creation or transformation that does not depend upon bodily continuity.[56] He opts to make the notion of death and a "victory over death" intelligible by developing his interpretation of resurrection independent of any consideration of physical transformation. According to Peacocke, Jesus' resurrection can be relevant to us—as beings whose bodies disperse upon death and eventually contribute to future life, even human life—only if we can be resurrected in the same manner as Jesus was. If Jesus' resurrection depended on the transformation of his physical body before decay had set in, an "insuperable, logical gulf" lies between us and him.[57] Peacocke argues that resurrection cannot depend upon bodily continuity and must, for Jesus and for us, constitute a "*re*-creation into a new mode of existence." [58] For Polkinghorne, the empty tomb of the resurrection proleptically announces the common eschatological destiny of humanity and all creation.[59] Although theology has, over the centuries, been rather ambiguous about nature's place in the consummation of creation,[60] Polkinghorne offers an account of Christian hope that establishes the credibility of the traditional theological claim of bodily resurrection by linking the transformed materiality of the resurrected Christ to the materiality of all creation. Peacocke, as I have shown, retreats from the traditional claim of bodily resurrection in his choice to situate the irreversible finality of physical death within the context of hope in God's ultimate affirmation of personhood.

Peacocke insists that if theology is to contribute to the intelligibility of the Virgin Birth, it must play the hand it has been dealt by science, while Polkinghorne defends the credibility of the narrative, even though it appears to be a biological impossibility.

Other examples could be adduced as well, but these five suffice to establish my claim that although Peacocke and Polkinghorne share a set of concerns that motivate their interest in theology of nature, they have strikingly different strategies for pursuing their work. Within Peacocke's strategy of intelligibility, the methods and ideas of science act as a tether on theological claims. One does occasionally find him employing the limits of science in support of theological claims, as in this remark:

> [U]ltimate ineffability in the nature of the divine parallels...our ultimate inability to say what even things and persons *are* in themselves.[61]

In general, however, he emphasizes the constraining role of science upon theology. Polkinghorne's strategy of credibility allows theology considerably more room to maneuver. His willingness to portray not only the strengths of the scientific method but also its limits yields a broader concept of human rationality designed to accommodate and support a wider range of theological claims. Significantly, Polkinghorne himself makes the following comment about the relation between his own approach and that of Peacocke:

> At issue [between Peacocke and myself] is the degree to which scientific concepts should be allowed to mould and influence the conceptual apparatus of theological thought, and the degree to which theology must retain (as science does unquestioned) its own portfolio of irreducibly necessary ideas.[62]

This is precisely the issue I have developed through my discussion of the strategies of intelligibility and credibility.

IV. Theology of nature's dilemma

In my argument that Peacocke and Polkinghorne employ distinct strategies for developing a theology of nature, two noticeably different ways of understanding what it means to "take science into account" have emerged. According to the strategy of intelligibility, theology ought to focus primarily on the actual details of scientific accounts of the world (scientific concepts and theories) and adjust itself accordingly, in order to participate fully in the human quest for meaning. On this account, theology should place heavy emphasis on incorporating scientific accounts of the world—the second theme of a theology of nature—and allow science to act as a constraint upon theology, pruning concepts and doctrines according to their congruence with scientific description. In contrast, credibility emphasizes detailed investigation of scientific methods (the first theme of a theology of nature) in order to equip theology with a more nuanced understanding of the inner workings of science and of the rich resources of human rationality, and thus to embolden theology in its defense of theological claims. On this account, science is understood to offer support to theology by contributing to a better understanding of the breadth and depth of human rationality and its capacity to encompass and sustain theological reasoning. Having presented my argument, I now want briefly to explore the relation between these two strategies. The obvious tension between them leads to the question of whether it is possible to decide which strategy is preferable. Ought one strategy be chosen over the other? And what considerations might enter into such a decision?

> ***Should theologians attempt to restructure theology along lines more consonant with scientific views, or should they resist such consonance, knowing that science, properly chastened, is not capable of vetoing theological claims, no matter how unlikely or strange?***

I propose dubbing the tension between these two strategies the "science dilemma," because, in fact, science *itself* pulls theology of nature in both directions. Or put more precisely, actual scientific accounts of the complex and interconnected world seem to encourage theological engagement, while careful examination of the processes of science (provided by recent philosophy of science) suggests that theology is justified in adopting a critical, self-confident, even self-reliant, attitude toward science and its description of the world. For any given point of apparent conflict between theological and scientific accounts of the world, the dilemma immediately appears: should a particular theological concept or doctrine such as physical resurrection be reinterpreted, revised, or abandoned in light of scientific knowledge, or should theology resist the implications of the relevant scientific account? More generally, should theologians attempt to restructure theology along lines more consonant with scientific views, or should they resist such consonance, knowing that science, properly chastened, is not capable of vetoing theological claims, no matter how unlikely or strange? What criteria might help in deciding between these two strategies? The historical irony here is that while numerous scientific developments of the twentieth century have stimulated a desire among theologians for bridge-building—in ways that would have been unthinkable for Ritschl—the methodological tools carefully assembled by theologians for entering into dialogue with the sciences have often seemed better suited for constructing observation towers than for building bridges.[63]

Furthermore, these two strategies present a dilemma for theology of nature rather than a straightforward choice because when taken individually, each strategy comes with considerable risks. While the strategy of intelligibility "plays fair" with scientific accounts of the world by allowing science to constrain theology, uncritical acceptance of this strategy hazards a theological capitulation to science that would ultimately disallow theology its central claims (such as physical resurrection). The strategy of credibility, on the other hand, correctly points us to a broader notion of human rationality, but a wholehearted embrace of this strategy raises the possibility of unduly immunizing theology against science's ability to safeguard our fallible epistemic endeavors from untethered conjecture (regarding, for example, the Virgin Birth).[64] The tension between these two strategies resists easy resolution. As a result, together they pose a genuine dilemma for the construction of a theology of nature.

Is there somewhere to turn for help in resolving this dilemma? Fortunately, a good deal has been written on the relation between science and theology in recent decades. To name only some of the more prominent figures who have written on this subject, I would mention Michael Banner, Ian Barbour, Philip Clayton, Niels Gregersen, Sallie McFague, Alister McGrath, Nancey Murphy, Wolfhart Pannenberg, Wentzel van Huyssteen, and Mikael Stenmark. Might these authors provide a way out of the science dilemma? I believe the answer is, unfortunately, no, though some have more to offer than others. In spite of the diversity of views and approaches taken by these authors, none offers an entirely satisfactory solution to the problem. Although it is beyond the scope of my argument in this paper to warrant this claim in detail, a brief summary will suffice to show why I believe these authors do not provide a solution to the science dilemma.

Much recent writing on the relationship between science and theology has taken the form of investigating the developments of twentieth-century philosophy of science, and then applying these developments to the issue of theological method. Given the difficult situation theologians faced in the middle of the twentieth century regarding the cognitive status of their claims, this was no doubt the best place to begin. The downfall during this period of the logical positivist paradigm of knowledge, which had reigned supreme during the early part of the twentieth century and which condemned theology outright as non-empirical and thus meaningless, meant that the most pressing task with regard to the relationship between theology and science was to marshal resources for reclaiming the integrity of religious belief and theological rationality. Two examples of this approach include early works by Barbour and Pannenberg.[65] Although each of these authors elsewhere engages the actual findings of science,[66] neither included in their discussion of the methodological characteristics and relationships of theology and science anything that might shed light on the science dilemma. Pannenberg, for example, in his magisterial *Theology and the Philosophy of Science*, dealt at length with the question of whether theology can be called a science, but nowhere attempted to develop a set of principles for clarifying whether or how theology should incorporate knowledge from the sciences. Barbour's discussion of the philosophy of science in *Myths, Models, and Paradigms* defended the referential character of religious language in light of recent philosophy of science, but did not go on to provide any sort of framework for enabling the critical interaction of scientific and theological concepts.

Building on Barbour and Pannenberg's early insights, others have followed a similar pattern in discussing the methodological relations between science and theology: introduce the thesis that theology "must take science seriously," but then develop it by arguing for the explanatory power and integrity of theology based upon a careful and critical interpretation of philosophy of science without any detailed discussion of how theology should critically engage the concepts and theories of science. Banner, for example, meticulously reviews developments in twentieth-century philosophy of science in arguing for the existence of parallels between scientific and theological methodology.[67] Clayton, following Pannenberg, focuses on the mediating role of the social sciences by constructing an epistemological continuum that would link types of knowing found in the physical sciences and theology.[68] McFague's insightful examination of the role of metaphor in theology draws on the place of metaphor in scientific discourse, but her work is largely devoid of reference to actual scientific accounts.[69] Similarly, van Huyssteen focuses in his early work on the quest for "epistemological credibility," through a careful discussion of philosophy of science; but he offers few references to actual scientific theories.[70] Nancey Murphy's discussion of theology's options for interacting with science mentions two strategies similar to those I have here designated as the science dilemma: (1) hybridization resulting from the incorporation of scientific theories into theological formulations, and (2) competition resulting from theology presenting its own view (e.g., of religious experience) as an alternative to a secular scientific account of the same phenomenon—but, again, she puts forward no criteria for considering what might make one option more appropriate than the other.[71] In a more recent contribution—which, disappointingly, breaks little new methodological ground—McGrath looks for points of methodological divergence as well as convergence, but concludes minimally that belief in God can be maintained in light of what science tells us (e.g., about the place of evil and suffering in the world).[72] Stenmark's recent helpful discussion of rationality in light of the epistemic limits encountered in everyday life likewise offers no insight for discerning how theological beliefs should be constrained by science, beyond arguing that all belief should remain open to criticism.[73] Gregersen, too, has no answer to the science dilemma; but he does at least lay hold of its basic structure:

> [T]heology always runs the double risk of either conflating theological and scientific language or of prematurely putting barriers to the coherence process.[74]

Despite much careful reflection and important insight into the relation between science and theology, none of the works mentioned above manages to go beyond an initial call for critical dialogue.

Nonetheless, this body of literature has succeeded in taking what must be considered a crucial step toward re-establishing connections from theology to science. The importance of these authors' insights regarding the philosophy of science vis-à-vis theology cannot be overestimated, especially in light of logical positivism's previous dismissal of theology, and neo-orthodoxy's subsequent refusal to engage science at all. And yet, in spite of this genuine advance, no set of criteria has appeared for deciding when theology should undertake to revise its claims in light of science and when it ought to resist such intrusions—the dilemma remains.

In light of the fluid nature of both theology and science, is it even feasible to ask for criteria for a critical theological appropriation of science? Granted, the task of exploring the degree to which science and theology—both living and changing traditions—share a common or analogous epistemology and draw from the same resources of human rationality is never finished. Nonetheless, theology's engagement with scientific concepts and theories cannot be postponed in anticipation of a definitive methodological account of their processes and relationship. Theology in the past has made better and worse assumptions about the physical world, and it will continue to adopt a particular working understanding of the processes and constituents of the world. If theologians cannot avoid the difficult task of responsibly appropriating scientific insights into theology, perhaps it is wise to see if recent insights can be leveraged in order to clarify what "responsibly" means.

In this regard, it is helpful to revisit the work of Philip Clayton, who in his *Explanation from Physics to Theology* asks what might count against theological assertions that appear to contain empirical claims, but which may not be immediately testable (e.g., the resurrection). Clayton lists three criteria: (1) internal contradiction, (2) empirical predictions that are falsified, and (3) tension between a theological assertion and the corresponding natural explanation.[75] Clearly, the second criterion appears to be a remote possibility for theology in most cases, but this may be an area in which theology should endeavor to adopt a more "scientific" character (depending, of course, on whether one opts for a more redescriptive view of theology, such as Gregersen's, or a more boldly predictive one, such as Murphy's). With regard to (3), unfortunately Clayton does not describe in detail the degree or kind of tension that would count against a theological assertion. He does, however, make the important observation that religious beliefs can never be evaluated individually, given the contextual constraints and demands inherent in theology.[76]

The central challenge for theology of nature is to avoid either inappropriately resisting science when it should be embraced, or inappropriately embracing science when it ought to be resisted.

In his most recent work, *God and Contemporary Science*, Clayton provides a more sustained answer to the question of what it means to take science seriously. Like Gregersen, he has a basic grasp of the science dilemma: the relevant theological goal, he says, is to develop a theology constrained, but not dictated by science.[77] He suggests several criteria for a responsible theological engagement with science: (1) openness to scientific results and the directions they point, (2) willingness to wrestle with tendencies that run counter to traditional theological answers, and (3) openness to revising dearly held theological conclusions. He goes on to specify two options for theology when faced with the task of rejecting the apparent implications of science: either (4) search for other reasons inherent within the sciences themselves to support the theological claim,[78] or (5) locate reasons that might be convincing from other fields such as history, ethics, or philosophy. Finally, he adds (6) the obligation to avoid misusing science by attempting to "prove" theological claims which ultimately must be judged on the basis of their theological adequacy (which will include, but not be limited to, taking their congruence with science into account).[79]

What should be made of Clayton's approach in relation to the present concern? While his criteria are helpful in evoking the attitude that theology of nature must hold toward science, and while he elucidates options for theology of nature if it chooses to remain in tension with science, the issue of whether to adopt or resist a particular scientific concept or theory remains hidden in the movement from criterion (3) to (4). In fact, Clayton thinks that an informed understanding of scientific conundrums and limits points to the need for a broader metaphysical discourse, a common framework for formulating agreements and disagreements, without which no further clarification can be attained on this issue. Having developed in this paper two strategies for theology of nature, which as an approach to integration explicitly rejects the idea of a relying upon a broader philosophical schema, to arrive now at an apparently unresolvable dilemma suggests that Clayton may indeed be right. Whether or not his approach could be successfully implemented without slipping into "systematic synthesis" is an issue that needs to be engaged, though I cannot address it here.

Why has the search for criteria by which to mount a critical theological appropriation of science proven so difficult, the criteria so elusive? In addition to Clayton's suggestion of the need for a broader metaphysical framework, I would like to conclude by drawing attention to one other possibility. Perhaps some clarity can be gained by rephrasing the concern. Instead of asking, "What constitute adequate criteria for a critical appropriation of science?" one might ask, "What would ensure the rationality of a theological decision to adopt or resist a particular scientific viewpoint?" As I have noted, the central challenge for theology of nature is to avoid either inappropriately resisting science when it should be embraced, or inappropriately embracing science when it ought to be resisted.

Wentzel van Huyssteen, in his discussion of Harold Brown's treatment of rationality, emphasizes the key role of judgment in all human cognition and argues for the impossibility of obtaining a guarantee or achieving certainty when faced with the choices presented by the science dilemma. Although criteria such as those being sought here may aid in decision-making processes, a shift from a rules-based understanding (or a criteriological conception)[80] of rationality to a judgment-based understanding locates rationality squarely within the agent who is making decisions, rather than in the logical relations between evidence and belief; such a shift seems to preclude any neat resolution to the science dilemma.[81] In accordance with van Huyssteen's view, Fraser Watts makes the following assessment:

> [The search for and deployment of] clear ground rules for evaluating how well particular theological accounts and scientific accounts sit alongside one another...[will] be a matter of judgment rather than of strict logic, not unlike the judgments scientists routinely make about how well a particular scientific theory sits with a body of data.[82]

Clayton, too, seems to agree that the process of judgment, which he defines as the formation of a "cognitive attitude," is ultimately beyond the grasp of any rules-based rationality.[83] For these authors, the human person and community emerge squarely at the center of the decision-making process, whether in science or theology. According to Calvin Schrag, what is needed, and in fact what an examination of human rationality shows we have, is the use of "criteria without criteriology."[84] In light of this important insight into the nature of human rationality, it would appear that any set of criteria one might develop can play only a supportive role as theology of nature seeks to be informed by science.[85]

Conclusion

As the need to include the accumulated wisdom of science within theological patterns and methods of reflection grows ever more pressing, appropriate means must be developed for critically engaging scientific methods, concepts, and theories. The approach identified in this paper, theology of nature, with its interest in scientific methods and accounts, its rich view of reality, its sense of God's engagement with creation, and its insistence on the significance of all creation for God's purposes, is well suited to the challenge of crafting a scientifically informed view of God, humanity, and the world.

Within this general approach, however, the strategies of intelligibility and credibility represent two different impulses: one to make sense of the world in which we live, and the other to make sense of the God in whom we live. These strategies stem from the same impulse—a desire to make sense of the connection between God and Creation—but move in opposite directions, one wanting to tether theological thought to the world as it is known through science, and the other wanting to abstract lessons from science about human rationality to yield a more expansive view of the rational resources available for theological reflection. In addition to adding a layer of clarification to Barbour's typology, the strategies of intelligibility and credibility provide a lens for understanding the related, but distinct theological agendas of Peacocke and Polkinghorne in their Gifford Lectures. The difficulty of establishing criteria by which to evaluate the merits of these strategies in relation to particular points of contact between theology and science constitutes what I have called the *science dilemma* for theology of nature. Whether or not the central role of judgment in the processes of human rationality precludes any neat resolution to the dilemma posed by these strategies is a question that demands further investigation. Nonetheless, in identifying these strategies and in pointing to the unresolved nature of their relationship, this paper has clarified theology's task as it seeks to develop a robust view of God, humanity, and the world in light of what is known through science.

Works cited:

Allen, Diogenes. *Christian Belief in a Postmodern World: The Full Wealth of Conviction.* Louisville, Ky.: Westminster/ John Knox, 1989.

Banner, Michael C. *The Justification of Science and the Rationality of Religious Belief.* Oxford Philosophical Monographs Series. New York: Clarendon, 1990.

Barbour, Ian G. *Issues in Science and Religion.* New York: Harper & Row, 1971.

_____. *Myths, Model, and Paradigms.* San Francisco: Harper and Row, 1974.

_____. *Religion and Science: Historical and Contemporary Issues.* Rev. ed. San Francisco: HarperSanFrancisco, 1997.

Clayton, Philip. *Explanation from Physics to Theology: An Essay in Rationality and Religion.* New Haven: Yale University Press, 1989.

_____. *God and Contemporary Science.* Edinburgh Studies in Constructive Theology. Edinburgh: Edinburgh University Press, 1997.

Galloway, Allan D. *Cosmic Christ.* New York: Harper, 1951.

Green, Joel B. "Restoring the Human Person: New Testament Voices for a Wholistic and Social Anthropology." In *Neuroscience and the Person: Scientific Perspectives on Divine Action*, ed. by Robert J. Russell, Nancey C. Murphy, Theo C. Meyering and Michael A. Arbib, 3-22. Berkeley: Center for Theology and the Natural Sciences, 1999.

Gregersen, Niels H. "A Contextual Coherence Theory for the Science-Theology Dialogue." In *Rethinking Theology and Science: Six Models for the Current Dialogue*, ed. by Niels H. Gregersen and J. Wentzel van Huyssteen, 181-231. Grand Rapids: Eerdmans, 1998.

Haught, John F. *Science and Religion: From Conflict to Conversation.* New York: Paulist Press, 1995.

Hendry, George S. *Theology of Nature.* Philadelphia: Westminster Press, 1980.

van Huyssteen, J. Wentzel. *Essays in Postfoundationalist Theology.* Grand Rapids: Eerdmans, 1997.

Lindbeck, George A. *The Nature of Doctrine: Religion and Theology in a Postliberal Age.* Philadelphia: Westminster Press, 1984.

McFague, Sallie. *Metaphorical Theology: Models of God in Religious Language.* Philadelphia: Fortress, 1982.

McGrath, Alister E. *The Foundations of Dialogue in Science and Religion.* Malden, Mass.: Blackwell, 1998.

Moltmann, Jürgen. *Religion, Revolution, and the Future.* Trans. M. Douglas Meeks. New York: Charles Scribner's Sons, 1969.

Murphy, Nancey C. *Theology in the Age of Scientific Reasoning.* Cornell Studies in the Philosophy of Religion. Ithaca: Cornell University Press, 1990.

Pannenberg, Wolfhart. *Theology and the Philosophy of Science.* Trans. Francis

McDonagh. Philadelphia: Westminster, 1976.

_____. *Toward a Theology of Nature: Essays on Science and Faith.* Ed. Ted Peters. Louisville, Ky.: Westminster/John Knox, 1993.

Peacocke, Arthur. *God and Science: A Quest for Christian Credibility.* London: SCM Press, 1996.

_____. *Theology for a Scientific Age: Being and Becoming—Natural, Divine and Human.* Theology and the Sciences Series. Minneapolis: Fortress Press, 1993.

Peters, Ted. "Theology and Science: Where Are We?" *Dialog* 34, no. 4 (1995): 281-96.

Placher, William C. *Narratives of a Vulnerable God: Christ, Theology, and Scripture.* Louisville, Ky.: Westminster/John Knox Press, 1994.

Polkinghorne, John C. *The Faith of a Physicist: Reflections of a Bottom-up Thinker.* Theology and the Sciences Series. Minneapolis: Fortress, 1996. (Published in the U.K.by SPCK as *Science and Christian Belief*).

_____. *Scientists as Theologians: A Comparison of the Writings of Ian Barbour, Arthur Peacocke, and John Polkinghorne.* London: SPCK, 1996.

_____, and Michael Welker, eds. *The End of the World and the Ends of God: Science and Theology on Eschatology.* Harrisburg, Penn.: Trinity Press, 2000.

Rescher, Nicholas. *Pluralism: Against the Demand for Consensus.* The Clarendon Library of Logic and Philosophy Series. Oxford: Clarendon Press, 1993.

Ritschl, Albrecht. *Justification and Reconciliation.* Vol. 3, *The Positive Development of the Doctrine.* Trans. H. R. Mackintosh. London: T & T Clark, 1902.

Rouse, Joseph. *Knowledge and Power: Toward a Political Philosophy of Science.* Ithaca: Cornell University Press, 1987.

Santmire, H. Paul. *Nature Reborn: The Ecological and Cosmic Promise of Christian Theology.* Minneapolis: Fortress Press, 2000.

_____. *The Travail of Nature: The Ambiguous Ecological Promise of Christian Theology.* Philadelphia: Fortress Press, 1985.

Schrag, Calvin O. *The Resources of Rationality: A Response to the Postmodern Challenge.* Bloomington, Ind.: Indiana University Press, 1992.

Stenmark, Mikael. *Rationality in Science, Religion, and Everyday Life: A Critical Evaluation of Four Models of Rationality.* Notre Dame, Ind.: University of Notre Dame Press, 1995.

Tianji, Jiang. "Scientific Rationality, Formal or Informal?" *British Journal for the Philosophy of Science* 36 (1985): 409-23.

_____. *Theology and the Justification of Faith: Constructing Theories in Systematic Theology.* Grand Rapids: Eerdmans, 1989.

Watts, Fraser. "Science and Theology as Complementary Perspectives." In *Rethinking Theology and Science: Six Models for the Current Dialogue*, ed. by Niels H. Gregersen and J. Wentzel van Huyssteen, 157-80. Grand Rapids: Eerdmans, 1998.

Welch, Claude. *Protestant Thought in the Nineteenth Century.* Vol. 2. New Haven: Yale University Press, 1985.

Endnotes:

1. Ritschl, vol. 3, p. 20.

2. Peacocke, *Theology for a Scientific Age*, p. 7.

3. Polkinghorne, *The Faith of a Physicist*, p. 7.

4. For an original and insightful reading of Kant—and Hegel, as well—on the problem of relating nature to spirit in light of the rise of modern science, see Galloway.

5. When Darwin published his controversial theory of biological evolution in 1859, the problem of relating spirit to nature was already firmly ensconced in the modern theological mind. The notion of common decent among species did, however, intensify this problem by inaugurating a detailed investigation into the connections between human and natural history. The variety of theologi-

cal responses to Darwin's theory is summarized in Welch, ch. 6, especially pp. 198-208.

6. In Ritschl's own words, nature's "lack of kinship with God" meant that it could not be "the direct object and the last end of his loving will" (Ritschl, pp. 219-28).

7. Jürgen Moltmann has commented succinctly on theology's retreat into the human realm: "Ostracized from cosmology by the natural sciences, Christian theology became anthropology" (Moltmann, p. 205).

8. See, for example, Green, pp. 3-22; and Polkinghorne and Welker.

9. On the question of natural theology, Polkinghorne suggests that although its focus on human reason rather than divine revelation has in the past led to perversions such as the "German theology" developed by part of the Church under Hitler, a genuine form of natural theology could nonetheless be integrated "with the rest of theological discipline in a single endeavor to learn of God" (*Faith of a Physicist*, pp. 42-43). Peacocke notes that natural theology has correctly been interested in what the sciences have to say about the world, even if God's presence has sometimes "been too readily discerned in details of the world's phenomena" (*Theology for a Scientific Age*, p. 99).

10. Barbour's typology also appears in chapter 4 of *Religion and Science*, which is a recently published revised and expanded version of his widely used *Religion in an Age of Science*. In his typology, the conflict and independence views share an oppositional understanding of the relation between religion and science, but independence avoids interaction by demanding strict separation between scientific and religious spheres of knowledge, whereas conflict sees only inevitable feud. Dialogue and integration share a more conciliatory attitude, but integration goes beyond dialogue's interest in comparing the general features of science and religion by developing direct relations between theological doctrines and scientific theories. For other typologies developed in response to Barbour's, see Haught, and Peters. It is helpful to remember that the use of the term "dialogue" in the conventional phrase "theology-and-science dialogue" refers to the interdisciplinary character of the discussion, not to the specific meaning Barbour reserves for the term "dialogue" in his typology (more on this below.)

11. Peacocke and Polkinghorne employ a wide range of terms to describe their approaches. Although both authors use the terms "intelligibility" and "credibility" through their writing, my choice to associate one term with a particular author reflects the differences I wish to highlight. Of course, neither strategy implies the other's negation: intelligibility does not imply incredibility any more than credibility implies unintelligibility.

12. A question related to but beyond the scope of this paper is whether theology can be understood as having legitimate reciprocal influence upon science. The challenge of creating a genuinely two-way interaction between theology and science is plagued with difficulties and dangers, but it is a question that any theology taking itself seriously as a description of reality cannot avoid. My discussion here assumes an explanatory role for (or cognitive dimension to) theology while acknowledging that theology plays other roles as well, such as expressing personal and social desires in the language of faith, guiding human conduct, and bringing a sense of meaning to life. This paper focuses specifically on characterizing two options available for a theology which wants to be informed by science but which takes its task to be more than mere redescription of the world given through science.

13. It should be noted that I am drawing on Peacocke and Polkinghorne for the specific purpose of identifying and characterizing these strategies. Thus, I do not provide an overview of Peacocke's or Polkinghorne's larger contribution to the theology-and-science dialogue, or even of the contribution they make in their Gifford Lectures. Neither do I argue that one finds the strategy of intelligibility, for example, consistently implemented across Peacocke's writings, or that either

author's theological views follow logically from the strategy he employs. An extension of my project might examine the historical development of Peacocke's and Polkinghorne's views on this issue. In Peacocke's writings, for example, I suspect one could observe a shift from an early affinity to natural theology to a later emphasis on theology of nature. Peacocke's use of the term "credibility" in the title of a more recent (1996) work, *God and Science: A Quest for Christian Credibility*, seems to suggest a further shift in his approach; but as it turns out, this short book is essentially a condensed version of *Theology for a Scientific Age* and shows no shift away from the strategy of intelligibility. In the preface of this book, Peacocke suggests that his approach is "not so much 'faith seeking understanding' [as with Polkinghorne and the strategy of credibility]...but rather 'understanding seeking faith'" (p. viii).

14. For Barbour's own discussion of integration, see his *Religion and Science*, pp. 98-105.

15. As of late, those allied with the Intelligent Design movement are attempting to revive the argument from structural complexity by appealing to the notion of improbability. Even if this strategy is ultimately judged to be successful—and I am doubtful that improbability is a helpful concept in the context of unrepeatable historical events—it would be no less susceptible to Hume's criticism than was the work of the seventeenth and eighteenth century British natural theologians: a gap remains between the relatively abstract notion of the existence of a divine designer and a particular understanding of, say, the Christian or Jewish God.

16. Barbour, op. cit., p. 105.

17. Ibid.

18. Ibid., p. 360.

19. For "theology of nature" in the narrower sense, i. e., assessment of the place of the natural world in Christian thought, see Santmire's work in *The Travail of Nature*, and *Nature Reborn*. For other examples of the term "theology of nature" used in distinction from "natural theology," see Hendry; and Pannenberg, *Toward a Theology of Nature*. It would perhaps be better for me to employ a new term here and keep "theology of nature" for reflection on the natural world in the narrower sense. For the time being, however, I have chosen to retain Barbour's terminology rather than adopt a more accurate but awkward term such as "scientifically informed theology."

20. I take this phrase from the title of the helpful assessment of the status of Christian belief in contemporary scientific culture provided by Allen: *Christian Belief in a Postmodern World: The Full Wealth of Conviction*. Similarly, van Huyssteen contends that we should be able to enter the interdisciplinary conversation between science and theology "with our full personal convictions, while at the same time stepping beyond the strict boundaries of our own intellectual contexts" (p. 33).

21. For a brief but clear survey and assessment of twentieth-century developments in the philosophy of science, see Jiang Tianji.

22. Polkinghorne, *Faith of a Physicist*, p. 46; Peacocke, *Theology for a Scientific Age*, p. x.

23. Peacocke, loc. cit.

24. Polkinghorne, op. cit., p. 7.

25. Theological interest in scientific methodology carries with it the benefit of increasing our general awareness of the fallibilist, hypothetical nature of all human knowledge. Although a theologian may reasonably engage the best-established scientific concepts and theories of the day, those with a special interest in and familiarity with science need to lead the way in the quest for theological provisionality, which will not only require theologians to work in a more fallibilist mode but may also bring them into proximity with more speculative scientific theories. To emphasize the hypothetical nature of theological statements is not to deny the commitment of religious faith, but rather to call attention to the fact that assent to theological claims

need not be taken to be inimical to an attitude of openness to criticism. Full acceptance of a particular belief need not entail absolute disregard for any future counterevidence. Holding one's commitments as "hypotheses" also comes from acknowledging that thoughtful people hold differing views. On this issue, see Murphy; van Huyssteen, *Theology and the Justification of Faith*, p. 83; Clayton, *Explanation from Physics to Theology*, pp. 140-41; Rescher, p. 121; and Stenmark, p. 295.

26. Peacocke, op. cit., p. 18.

27. Ibid., p. 41.

28. Polkinghorne, *Faith of a Physicist*, p. 156.

29. Peacocke, op. cit., p. 41; cf. pp. 224-25.

30. Ibid., p. 160-63; Polkinghorne, op. cit., p. 163.

31. Barbour, *Religion and Science*, p. 101.

32. Peacocke, op. cit., p. 131; Polkinghorne, op. cit., pp. 61-63.

33. See Placher, for example.

34. Polkinghorne, op. cit., p. 62; compare to Peacocke, op. cit., pp. 126-27, in which God is even more closely associated with the suffering of the world.

35. Barbour, op. cit., pp. 102-3.

36. Peacocke, *Theology for a Scientific Age*, p. 181.

37. Ibid., p. 306.

38. Ibid., pp. 314, 23.

39. Polkinghorne, *Faith of a Physicist*, p. 69.

40. Ibid., pp. 86, 164.

41. Peacocke, op. cit., p. 87.

42. Ibid., p. 5.

43. Polkinghorne, op. cit., p. 6.

44. Peacocke, op. cit., p. 91.

45. Ibid., p. 18.

46. Joseph Rouse has argued, perhaps a bit too strongly, that "there are no generally applicable standards of rational acceptability in science. There is only a roughly shared understanding of what can be assumed, what can (or must) be argued for, and what is unacceptable for any given purpose and context" (p. 124). In general, though, I find helpful Rouse's attempt to articulate a mediating philosophical position between the resistance of Continental philosophy to the totalizing posture of science and the Anglo-American inclination to accept science as the example par excellence of rationality. His balanced postmodern philosophy of science adroitly draws attention to the difficulty of applying standards with such a high level of generality as those identified by Peacocke. In section IV, I call attention to the limitations of a criteriological approach to rationality, regardless of the level of generality.

47. Polkinghorne, op. cit., pp. 6, 25; chapter 2, passim, particularly pp. 53, 59, 70, 89.

48. For Polkinghorne's own characterization of bottom-up versus top-down thinking, see ibid., p. 11.

49. Peacocke, *Theology for a Scientific Age*, pp. 275-79. Or, as he says elsewhere, Jesus "must be not only flesh of our flesh and bone of our bone, but also DNA of our DNA" (*God and Science*, p. 76).

50. Polkinghorne, op. cit., pp. 144-45.

51. Peacocke, *Theology for a Scientific Age*, pp. 214-48.

52. Ibid., pp. 211.

53. Polkinghorne, op. cit., p. 26.

54. Peacocke, op. cit., p. 176, emphasis original.

55. Polkinghorne, op. cit., p. 78.

56. Peacocke, op. cit., pp. 285ff.

57. Ibid., p. 332.

58. Ibid., p. 285, emphasis original. Peacocke is undoubtedly right in arguing that resurrection cannot depend upon atom-for-atom bodily continuity. But it does not follow from this that materiality has only a preliminary role to play in God's purposes regarding the fulfillment of creation, a view that Peacocke seems generally inclined to accept in *Theology for a Scientific Age*. Jesus, according to Peacocke, defines humanity, "not by its origins in the physical, biological and social worlds but in terms of what God intends humanity to become. In and through

Jesus the Christ we have come to see what human personalness can amount to. In his life and death, and supremely, in his resurrection, we see...the immanent Creator [bringing] created personalness out of materiality into the divine life" (p. 344). Granted, Jesus marks the fulfilment of humanity, but why limit Jesus' action to creating "personalness out of materiality"? If, as Peacocke has previously argued, there is no basis for asserting that any particular level of reality is "more real" than any other, why dismiss the idea of a common destiny for the whole created order, "splendid though such a hope would be" (p. 285)? My judgment here is that Peacocke's lingering anthropocentrism works against his broader theology-of-nature agenda—as when, for example, he employs the controversial notion of nature's "propensity" for manifesting consciousness to argue for "the emergence of self-conscious persons...as the intention of God continuously creating through the [natural] processes" (p. 221; see also pp. 62-69). Polkinghorne, despite generally being the more theologically traditional of the two, more consistently renounces this anthropocentrism. Peacocke's Christ lacks the cosmic import one would expect from such a detailed and profound vision of God's involvement in the world as one finds in *Theology for a Scientific Age*.

59. Polkinghorne, *Faith of a Physicist*, p. 164.

60. See Galloway; and more recently, Santmire, *The Travail of Nature*.

61. Peacocke, *Theology for a Scientific Age*, p. 102, emphasis original.

62. Polkinghorne, *Scientists as Theologians*, p. 82.

63. The relationship between these two strategies is identified in somewhat different language by Schrag, who refers to "the dialectics of participation and distanciation" (p. 65) in his discussion of the "transversal" nature of rationality. Although the dynamism implied by the word "dialectics" makes his an apt characterization of the movement of the rational agent's engagement with multiple intellectual communities and discourses and across disciplinary boundaries, I use the term "dilemma" to signal my unwillingness to accept the lack of precision implied by the term "dialectics" for the problem of relating intelligibility and credibility.

64. A self-serving assessment of the philosophy of science completely devoid of Polkinghorne's sophistication is given in a brief review of Thomas Kuhn's well-known *The Structure of Scientific Revolutions*, found in the article entitled "The Greatest Books of the Twentieth Century," printed in the fundamentalist magazine *World* (July 3/10, 1999): "Kuhn showed why Christians do not have to fear science anymore. It keeps changing." More sophisticated but equally appreciative of Kuhn's insights on rationality, George Lindbeck writes, "Reason places constraints on religious as well as on scientific options even though these constraints are too flexible and informal to be spelled out in either foundational theology or a general theory of science" (p. 131).

65. Barbour, *Myths, Model, and Paradigms*; Wolfhart Pannenberg, *Theology and the Philosophy of Science*.

66. See, for example, Barbour, *Issues in Science and Religion*, esp. Part III; Pannenberg, *Toward a Theology of Nature*.

67. Banner.

68. Clayton, *Explanation from Physics to Theology*. A similar discussion of the hermeneutical character common to all science, but one which does not touch on the topic of religious belief, can be found in Rouse.

69. McFague.

70. van Huyssteen, p. 196.

71. Murphy, pp. 198-99.

72. McGrath, pp. 94-98. It remains to be seen how McGrath will deal with the science dilemma in the series he has promised will follow on specific scientific and theological topics.

73. Stenmark.

74. Gregersen, p. 215. Gregersen's discussion of seeking coherence at the different levels of data, theory, thought models, metaphors, and worldviews, is illuminating but unhelpful for my present purposes because he talks

of the need for critical incorporation of science at various levels without ever specifying what "critical" means.

75. Clayton, op. cit., p. 130.

76. Ibid., p. 133.

77. Clayton, *God and Contemporary Science*, p. 161.

78. Fraser Watts suggests one such possibility, namely, that one is entitled to reject a constraint if a particular scientific view in question is deemed to be an unwarranted extrapolation from the data; p. 177. In this case, however, the science in question is bad science, which obviously doesn't deserve theological consideration. But this only begs the question of what counts as genuine science.

79. Clayton, op. cit., p. 8. His discussion of a "presumption of naturalism" (pp. 173ff) on the part of the believer appears to bias his approach toward the strategy of intelligibility and the theological program of Peacocke. In fact, in the preface (xi) he identifies the project of *God and Contemporary Science* as a complement to Peacocke's work in *Theology for a Scientific Age.*

80. Schrag, p. 53.

81. van Huyssteen, *Essays in Postfoundationalist Theology*, pp. 247ff.

82. Watts, p. 178.

83. Clayton, op. cit., p. 180.

84. Schrag, p. 60. Moreover, as Paul Feyerabend argues, criteria are typically not set up in advance of the concepts and theories upon which they are brought to bear: "they are often constituted by them and they must be introduced in this manner or else research will never get started" (from his *Farewell to Reason*, quoted in Schrag, pp. 60-61).

85. As van Huyssteen points out, the task of establishing criteria would be made even more difficult on a postmodern view of science as characterized by local practices which do not fit neatly into a unitary vision of science (*Essays in Postfoundationalist Theology*, p. 278). Such a view suggests that no single set of criteria would be adequate across the sciences.

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The New England Center for Faith and Science Exchange awarded Mr. Metzler a year 2000 Publication Prize for this essay.

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An Exploration into the Ethics of Cloning Endangered Species

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Researchers are cloning endangered species, expanding the debate on human cloning to include both the value of evolution and the question of whether ethical issues affecting endangered species should be defined in terms of human medical benefit. In this paper, the author explores these questions and others with evolutionary biologist Kathryn Rodriguez-Clark, philosopher Holmes Rolston, III, and toxicologist Don Sparling. Whether or not we are ready to formulate ethics on the subject, if we do not enter into a serious dialogue now, then we allow the question of whether to clone any species—including our own—to be decided for us.

The possibility of cloning became real in 1997 when Dolly, the cloned ewe, entered the natural world. Global debate ensued, and President Clinton initiated a Congressional hearing that concluded with a ban on the use of human embryos in federally-funded medical research for five years. Even with the reality of Dolly, there remained important unresolved questions concerning cloning, and many scientists thought that they would never be faced with actually having to answer the difficult questions concerning the ethics of cloning.

Two of the research hurdles to cloning are explained below in Excursus 1. One involved the length of the teleomere, the biological clock of chromosomes. If teleomeres could not be returned to their length at the time of birth, clones could never be produced with a normal lifespan; they would be born at the biological age of their genetic twin. Another hurdle involved the donated chromosomes themselves. Early in the life of an embryo, its DNA differentiates to produce the different tissues that make up the future animal. If DNA cannot be returned to its original undifferentiated state, a new individual can never be produced. Great discoveries have been made during the last few years, and when the ban is reevaluated in 2002, cloning will be a reality and the debate will be historical.

Continued research on the cloning of animals was never banned. The November 2000 issue of *Scientific American* contained a paper presented by researchers at Advanced Cellular Technology (ACT) in Worcester, Massachusetts, describing their work in cloning endangered species, such as the guar, the Sumatran tiger and the giant panda. The ACT researchers also entertain the possibility of reincarnating the already-extinct African bongo antelope and support ongoing projects elsewhere to clone deceased domestic pets. The newest science of cloning involving somatic cell nuclear transfer is explained in detail in Excursus 2.

Dr. Betsy L. Dresser is one of three ACT researchers cloning endangered species. She holds the Virginia Kock endowed chair in endangered species conservation at the University of New Orleans and is vice-president of the Audubon Institute for Research of Endangered Species. The Institute outlines its position on the ethics of cloning endangered species on its website in a statement by CEO Ron Forman:

> More animals will become extinct in our lifetime than at any other time in the history of mankind. If mankind is responsible for this extinction, then we also have the responsibility to act on behalf of these species. We at Audubon Institute are developing technology to freeze and stockpile reproductive material, using common, non-endangered animal surrogates to increase the birthrate for endangered species, until those species are threatened no more. This science is a major step towards eradicating extinction.

It is clear that ACT researchers uncovered an emotionally-charged deep pocket already established to conserve endangered species in order to fund their own research on cloning. As a consequence, questions concerning the ethics of cloning now include a myriad of totally separate issues that impact endangered species and are of utmost importance in shaping how we respond to our serious environmental problems of the 21st century.

The question of cloning is now before us, whether or not we are ready as a society to formulate ethics on the subject. If we do not examine the controversy now, we will become used to and accept the idea of cloning. Without ever entering into serious dialogue, we could allow the question of whether to clone any species, including our own, to be decided for us.

Because endangered species are being cloned, I am interested as a student of conservation biology in exploring these new areas now included in the cloning debate. I presented a set of questions to three scholars from different disciplines, to examine how their responses would differ from my own. Only by beginning such a dialogue can any of us understand how the decisions before us will impact the future of humankind and all life on earth.

I interviewed evolutionary biologist Kathryn M. Rodriguez-Clark,[1] philosopher and environmental ethicist Holmes Rolston, III,[2] and Don Sparling,[3] a wildlife biologist and toxicologist. No ACT researcher responded to my requests for an interview.

The discussion that follows includes fascinating and thoughtful responses that were often diametrically opposed.

Question 1. *Would you respond differently to a cloned individual of an endangered species than you would to one born in a wild population?*

Holmes Rolston, III, answers, yes, the clone has a different historical genesis from the wild individual. The appropriate response to the clone is to be impressed with the human technicians, and the appropriate response to the wild animal is to be impressed with the animal.

I also answer, yes. I believe that evolution is a force included in the divine, and because a clone is produced by humans and does not originate from within evolution, it lies outside of our shared oneness with the universe. On the other hand, because a clone has life, I cannot deny that it has worth.

Don Sparling responds from a different perspective. He does not think that there would be any real difference between a cloned and a wild individual if the clone were taken from a wild individual. Clearly, if the clone had come from an individual that was part of a long line of captive bred individuals, differential selection could (and probably would) have occurred on that captive line compared to a wild line. Captive selection has been well documented. In the same way, a cloned animal is a chimera, not equivalent genetically to the original species, and most likely would not have the same fitness as a wild animal.

Question 2. *Does a species have value outside of its natural ecosystem? If so, how is its value affected if it is extinct in wild nature and exists only in a zoo or preserve?*

Don Sparling believes that most definitely a species has value outside of its natural ecosystem, although that value might be compromised. First, captive animals can serve as genetic reservoirs for the species at large. If conditions that led to the endangerment or extinction of a species in the wild can be corrected, captive individuals would be the only source for re-establishing the species. Captive programs are now sufficiently sophisticated to assure that the inbreeding coefficient can be kept at a manageable level. Secondary values for animals outside of their ecosystem include:

(a) As a possible surrogate for more endangered species. For example, during the 1980s Patuxent used Andean Condors as surrogates for testing medications and procedures before using them on the even rarer California condors.

(b) As a possible benefit for the human species in providing medicines, etc. A problem that can occur, however, is selection pressure due to captivity, which could select for more docile, easier-to-handle animals or more cultivable plants that may not be as wary as wild animals or resistant as wild plants.

Kathryn Rodriguez-Clark agrees that a species has value outside of its natural ecosystem, for educational purposes at least, and possibly economic ones. She uses African violets as an example, which are extinct in the wild.

Holmes Rolston, III, answers from a different perspective, noting that species have reduced value in zoos; they become museum pieces, not animals living on their own with their own defended integrity.

I, too, answer from this perspective. I believe that a species has less value outside of its natural ecosystem, but its value depends on why the species now exists outside of its natural ecosystem. As a representative individual of an extinct species, it has little value, since it only represents our failure to preserve it. I agree with Don Sparling, however, that a species in captivity has value both as a genetic reservoir and as a research subject for endangered species that have wild populations in protected ecosystems.

***Question 3.** Should cloned endangered species be introduced into the wild to breed with remaining but still endangered populations?*

Kathryn Rodriguez-Clark makes the interesting observation that it depends on how the cloning is done. If eggs from another species are used, then probably cloned individuals should not be introduced into wild populations because of all the extra-species mitochondrial and cellular material introduced, which could have unforeseen impacts.

She further explains that most efforts at "cloning" do not produce a true clone but involve denucleating an egg of one individual that may be from a different species, and inserting into this egg the nucleus of the "target" species. Thus the result is a chimera, an individual that possesses the mitochondrial DNA and some cellular machinery of one species, and the nuclear genome of another species. Not much is known about how these two genomes interact, but since mtDNA is key for cellular respiration, it is likely they do interact in significant ways.

Don Sparling answers that if great care were taken in raising and selecting cloned individuals to avoid the problems discussed earlier, there should be no problem. From a population genetics perspective, the genotype and relevance of the clones are indistinguishable from that of the parent individuals. He adds:

> It is my belief that especially plants and probably non-human animals do not have any particular divine characteristics such as souls which would confound the ethical aspects of such decisions. However, the theological implications of such activities have not been sufficiently pondered.

Sparling thinks that cloning only a few individuals would be like conducting a toxicity study on a statistically insufficient number of individuals: this action could be more detrimental than no action at all. It is an oxymoron to consider a few individuals representative of a species, for the species is the sum of its genetic variability.

Holmes Rolston, III, cautions, "Certainly not until we are sure whether the clone is normal in all respects in genes, morphology, behavior."

I, however, am continuing to evaluate my position. Cloning endangered species should be considered neither as a strategy to avoid the extinction of a species, nor as a measure as important as preserving habitats and ecosystems. I also do not believe that cloning should be considered of equal value to reproduction through natural means, where the diversity of the genotype is protected. However, I believe that cloning may have a place where all other means of preserving a species fail.

By taking advantage of an open niche, human beings became intelligent; but they assumed additional responsibilities, not additional rights.

Question 4. *What importance does the theory of evolution hold for you personally?*

We all agree that that evolution has a great importance for us personally, although our reasons may be different. Don Sparling responds:

> I believe in the theory of evolution in the sense that natural environmental changes occur that can alter the composition of genomes and cause gradual change in species or the formation of new species out of preexisting ones. That all of this occurs solely by random, stochastic events, and that out of this randomness has come the complexity of nature at the macro and micro-levels exceeds my credulity.

Question 5. *Should we clone only a few representative individuals of an endangered species, or should enough genetic diversity be preserved for evolution to continue in the species?*

I believe that as our scientific understanding of evolution expands, it precludes the notion that cloning is a vehicle for preserving evolution. Evolution arises from potentially adaptive mutations, and because these mutations are only a fraction of the total number of mutations occurring in an evolutionary dynamic genome, many genetically separate individuals are required to support continued evolution. Perhaps the number of individuals needed to preserve evolutionary viability is greater than 5000.[4] Thus, regardless of other problems that this question suggests, the number the of genetically different individuals needed to even approach the successful preservation of evolution is much larger than our capacity to respond by cloning.

Don Sparling thinks that cloning only a few individuals would be like conducting a toxicity study on a statistically insufficient number of individuals: this action could be more detrimental than no action at all. It is an oxymoron to consider a few individuals representative of a species, for the species is the sum of its genetic variability. The less of that variability that is present in the cloned population, the less it represents the species. While one might be able to establish a "showcase" species, what would be produced from a few individuals would hardly suffice to represent the species as it once was.

Continuing, he says that deciding on how many animals or plants are necessary to be representative is much more open to argument, especially since we may not have any idea on how much genetic variability existed or needs to exist to be representative. If a measure of genetic diversity were available, would it be from a time when the species was healthy and robust or when it was severely decimated and consisting of only a fraction of its potential diversity? Would 50% of the potential diversity be adequate? 75%? 90%? From a practical aspect, we may have only a few individuals from which genetic material could be extracted. In that case, whether the species was "restored" would be debatable, even if the progeny of the cloned individuals reached the hundreds or thousands. Evolution would occur in any case but the results of that evolution may or may not be the same as if the species had not become endangered or extinct.

Holmes Rolston, III, answers that it depends on whether the goal is to have museum pieces or animals with wild integrity. The number of individuals that must be cloned to provide that diversity depends on the species and the genetic pool required. Evolution from clones is not evolution by natural selection and, therefore, not evolution in the usual sense.

Kathryn Rodriguez-Clark does not think that cloning is ever likely to be a mode of "preserving" a species, except perhaps by generating enough interest and money to be put toward preserving wild habitat and supporting other in situ conservation efforts. Most captive-bred species are barely self-sustaining, much less capable of surviving re-introduction in the wild. However, there obviously are some notable exceptions, such as black-footed ferrets and whooping cranes, species that can be induced to breed readily in captivity. Rodriguez-Clark believes that genetic variation is obviously important, but so many other issues are normally far more important in determining the persistence of an endangered species, such as habitat loss, direct exploitation, lack of political will and institutional continuity, and even how "cute" and appealing it is to the public.

***Question 6**. Scientists involved in cloning research state that the knowledge we will gain will increase our understanding and treatment of human diseases. Should we define the ethical issues affecting endangered species in terms of human medical benefit?*

Don Sparling explains that conserving biodiversity, which is part of what we are discussing, benefits all species. Human beings are a natural part of the environment because we are part of nature, although a unique part. So, yes, some of the benefit of being able to clone and maintain endangered species can be measured in terms of human health, although this in no way should be the primary value.

He makes a comment at the end of his interview that I think expands upon his answer here. The cloning of endangered species or any nonhuman species should not be equated with the cloning of human beings. Although we might allow the cloning of nonhumans (keep in mind that we do that all the time with plant cutting and shoots—and many endangered species are plants) only human beings are made in the image of God.

Holmes Rolston, III, disagrees. He believes it is doubtful that the knowledge gained from cloning endangered species will increase the understanding and treatment of human diseases. Neither does he believe that the ethical issues affecting endangered species should be defined in terms of human medical benefit.

Kathryn Rodriguez-Clark also disagrees. She answers that it seems simply false that we will increase our understanding and ability to treat human diseases through cloning endangered species. There are already plenty of studies of human monozygotic twins, who are natural clones, which have contributed immensely to the understanding of diseases. Cloning endangered species would, if anything, have the goal of preserving as many different genotypes as possible, whereas in a disease study context, the value would be in having many, many replicates of the same genotype, which is why highly inbred lines of mice are used. These goals are diametrically opposed.

I read the testimony of Dr. Michael West, president and CEO of ACT, who explained to Congress that cloning technology is an essential process in modern biomedical research to help us learn how to reprogram genes to develop different types of cells and create different proteins needed in the treatment of many diseases. I also read the debates of bioethicists supporting human cloning who focus their argument on the benefit to human reproduction, arguing that it is a fundamental and a constitutionally guaranteed right. I do believe that medical research should be allowed to proceed on animals, if the knowledge it produces increases our knowledge of life.

However, I believe we should not define the ethical issues affecting endangered species in terms of human medical benefit. Their gene pool is from whence we came: we share most of our genes with them. Where did human beings step out of the flow of history and assume a different path? Drummond believes that, by taking advantage of an open niche, human beings became intelligent; but they assumed additional responsibilities, not additional rights. Perhaps expanded human consciousness enables the capability of deeper fulfillment, but we must rethink the concept of human rights in order to comprehend how we fit into the whole of the cosmos. We have the intelligence to work within the cosmos, but not the right to have command over it.

Sparling foresees that if cloning became acceptable it would become another tool in the arsenal to maintain biodiversity and species. As a result, it would become part of organized programs that include habitat restoration and sustainability. It would not supplant these programs.

Some may introduce here the argument that because natural evolution produced humans, all that we do is natural, that we have a right to do it because we can. I want to expand on the answer given by Holmes Rolston, III, to include his thoughts in *Conserving Natural Value*. "We are not discriminating enough to see that, though humans evolve out of nature and its processes, we significantly *evolve out of it*." Evolved out of nature, human culture must remain in relative harmony with nature. Although all deliberate human behavior is different from the process of spontaneous nature, behavior that agrees with natural systems is healthy for human beings, and behavior that does not is not healthy.[5] Defining human medical benefit in terms of the ethical issues affecting endangered species places us outside of relative harmony with nature and is not healthy.

Question 7. *If endangered species are cloned, do you believe that momentum and funding will be lost in efforts to conserve them by other means, such as breeding programs and protecting and restoring their natural ecosystems and habitat?*

Kathryn Rodriguez-Clark does not believe momentum and funding will be lost. It would probably raise public awareness and lead to a rising tide that might raise all boats, which is why I'm not against cloning altogether.

I think there are enough intelligent, well-informed folks out there that if trends started in that direction, there would be huge outcry. I do think it is important that the scientists who are actually doing the cloning are clear on this point, though, that cloning is more along the lines of basic research and may never have any applied use toward species conservation. This debate seems to me to be quite similar to the debate about "putting a man on the moon." It has not led to peopling the moon, but it generated enormous support for basic research in physics that has led to all sorts of unexpected bonuses (like velcro, for instance).

Don Sparling agrees that momentum and funding will not be lost. Because of the difficulty of cloning (and breeding) compared to breeding extant populations, whenever possible the emphasis will be placed on breeding. The value of cloning decreases dramatically if there are already a sufficient number of organisms to breed in captivity in safe preserves. Also, there is not much value in simply cloning a species if there is no habitat available, unless one wishes to produce a showcase species; but costs and problems would keep that possibility down to a minimum.

Holmes Rolston, III, disagrees with them. He responds that a belief in ex situ conservation undermines in situ conservation.

I agree with him. I am deeply concerned that cloning endangered species will divert concern for species currently facing extinction. Species under stress have benefited because of the intense interest in breeding programs and the protection of ecosystems. This work is funded because we are concerned. If we convince ourselves that we can clone endangered species, to preserve them until we can figure out how to reestablish their ecosystems, we lose a great deal of the little time we have left.

Question 8. *If endangered species are cloned, will it decrease the urgency to make our own environment sustainable, by leading us to believe that we can reconstruct it all later?*

Don Sparling responds that he foresees that if cloning became acceptable it would become another tool in the arsenal to maintain biodiversity and species. As a result, it would become part of organized programs that include habitat restoration and sustainability. It would not supplant these programs.

Kathryn Rodriguez-Clark agrees. The idea that cloning endangered species will decrease the urgency to make our own environment sustainable by leading us to believe that we can reconstruct it all later is simply ridiculous.

Holmes Rolston, III, sees this from a different perspective. People pushy enough with their technology to clone endangered species think well of themselves and their technology. They are likely to believe in a technological fix for everything.

I agree with Holmes Rolston, III,. I believe this is a major hazard of cloning endangered species, as it is human nature to put off until later changes that need to be made now and will lead us to postpone developing real solutions until we face a major crisis.

Question 9. *Do you believe that an extinct ecosystem can be reestablished after it is destroyed by human development? Could it be made sustainable? Could cloned endangered species and other species natural to the extinct habitat be introduced into the new ecosystem with the expectation that they would survive?*

Kathryn Rodriguez-Clark explains that if an "extinct ecosystem" is one in which all constituent species have gone extinct, then obviously no. In any given area of land, there are hundreds, if not thousands of species. Bringing them back is simply impossible.

Don Sparling agrees, explaining that we are very far from being able to synthesize ecosystems that come anywhere near a natural ecosystem. The answer is, "No, not at this time. The other parts of the question rest on that answer."

Holmes Rolston, III, believes that an ecosystem locally extinct might be restored, if there is another one elsewhere from which source material can be taken. Ecosystems globally extinct cannot be restored; nobody would know enough about what was there before to know how to restore it. If the ecosystem is otherwise intact, presumably a reintroduced species could survive, no matter whether cloned from individuals in zoos or restocked with wild individuals from other habitats. Yellowstone wolves came from Canada. They could have as well, under a perfect cloning scenario, have been cloned.

But in fact, Rolston continues, many species have all sorts of acquired behaviors they imprint from their parents, and just cloning an individual genetically does not reproduce the formative forces on the phenotype beyond the genotype.

I agree with everyone. An ecosystem is not just an area where species come together and live. There is a unique dynamic moving through every habitat and every ecosystem. It is a product of chance, of stochastic events, and timing. We have no way of knowing when or in what order species were originally introduced. An ecosystem is a product of its unique history and cannot be repeated. The only way to have the original ecosystem is to preserve it in its original totality.

Question 10. *If you were faced with the decision today (and you are), would you support the cloning of endangered species? Please answer either Yes or No.*

Kathryn Rodriguez-Clark responds, "Yes, but not as a 'conservation technique,' since it simply isn't."

Holmes Rolston, III, responds, "I'd have to see on a case by case basis. Presumably, no."

Don Sparling responds, "Yes."

And I respond, "No."

Excursus 1: Recently removed obstacles to the reality of cloning

A. Returning a differentiated cell to its original undifferentiated state

Somatic cells donated by an adult contain a complete set of DNA. If they are, for example, skin cells, the genes that code for skin are activated and the remaining genes were turned off during fetal development. Early embryologists believed that DNA could never be returned to its original undifferentiated state, able to begin again, to differentiate a second time and grow a second complete animal. However, recent research has identified certain growth factor proteins in the cytoplasm of an egg that are capable of retroprograming DNA, returning it to its original and undifferentiated state, enabling the cell to replay its growth.

B. How old is a clone?

A second problem, considered by some to be insurmountable during the 1997 Congressional hearings, centered around the length of the teleomere on the chromosomes from the somatic cell. Each strand of DNA ends in a sequence of genes called the teleomere, a biological "bookend" that holds the gene sequences in place. When chromosomes replicate, the two strands of the DNA double helix separate, and a group of enzymes known as DNA polymerases catalyze the synthesis of new strands. Each time the chromosome replicates, a tiny segment of the teleomere is lost, and when all segments of the teleomere have been lost, the cell dies. A teleomere is a kind of molecular clock.

It was thought that clones would never have a normal life span, that they would be born with teleomeres the same length as the somatic cell and begin life at the age of the donor. In April of 2000, Dr. Robert Lanza of ACT discovered that not only can teleomeres be returned to their original length, but they can be made longer. He announced that not only could clones be produced with an anticipated normal lifespan, but that the longer teleomeres could produce an exceptionally long lifespan. It would be possible, he announced, that cloned humans could live to 180 or perhaps 200 years.

To produce the long teleomeres, Dr. Lanza allowed the somatic cells to continue to divide until 95% of their lifespan was used. The DNA from these aged cells was then inserted by nuclear transfer into the denucleated egg cell. He had conducted this research on calves, and the resulting cloned calf was not only normal, but had teleomeres long enough to complete 91 cell divisions ithirty more than 61 cell divisions expected during the normal lifespan of the animal.

Excursus 2: The science of cloning by nuclear transfer

Cloning by nuclear transfer begins with the donation of an ovum from one donor and a somatic cell from a separate donor.

An ovum is the product of two meiotic divisions during which the chromosomes divide equally but the cytoplasm does not. Most of the cytoplasm contained in the primary oocyte remains in only one of the two cells produced by each division. The polar bodies, the other cells produced with each meiotic division, receive chromosomes but very little cytoplasm. Cytoplasm contains not only stored nutrients, but ribosomes, mitochondria, enzymes, and organelles (centers for protein assembly, energy production and respiration). The chromosomes in the polar bodies are sacrificed to assure that the ovum can best support an embryo.

An ovum is a sac within a sac. The innermost sac is the egg, which is covered by the plasma membrane. The final polar body produced by the second meiotic division lies just above the plasma membrane but beneath an outer protective membrane, called the zona pellucida. After the ovum is harvested, it is matured in a culture dish. During cloning, the ovum is held by creating suction through a hollow pipette against the zona pellucida. Then, the ovum membranes are punctured by a thin needle through which the chromosomes and polar body are removed, leaving only cytoplasm and the membranes behind.

A somatic cell is harvested from a separate donor to supply the genetic material of the clone. Somatic cells are any cell other than a reproductive cell. Somatic cells are used to supply the chromosomes, because they divide by mitosis, which produces two cells each with a complete set of chromosomes and equal amounts of cytoplasm. The somatic cell is also matured in a culture dish. During nuclear transfer, the entire somatic cell is inserted into the cytoplasm of the ovum between the outer zona pellucida and the inner plasma membrane. Then, the cell is submitted to a tiny electric pulse of AC voltage that perforates the nuclear membrane of the somatic cell and the inner membrane of the egg. A second pulse, this time of DC voltage, fuses the membranes. These two tiny electric shocks mimic the process of natural fertilization. The sperm head, or acrosome, penetrates the zona pellucida and produces a burst of calcium ions, a biological DC electric shock, that causes the membranes of the two cells to fuse. A few hours later, during both natural fertilization and nuclear transfer, the ovum carrying the somatic cell nucleus begins to divide.

Works cited:

Cole-Turner, Ronald, ed. *Human Cloning: Religious Responses.* Louisville: Westminster John Knox Press, 1997.

Curtis, Helena, and N. Sue Barnes. *Biology.* 5th Ed. New York: Worth Publishers, 1989.

Hamer, Dean, and Peter Copeland. *Living with Our Genes: Why They Matter More Than You Think.* New York: Doubleday, 1998.

Lande, Russel. "Extinction Risks." In *Genetics and the Extinction of Species*, ed. by Laura F. Landweber and Andrew P. Dobson, 47-75. Princeton: Princeton University Press, 1999.

Landweber, Laura F., and Andrew P. Dobson, eds. *Genetics and the Extinction of Species.* Princeton: Princeton University Press, 1999.

McGee, Glenn, ed. *The Human Cloning Debate.* Berkeley, Cal.: Berkeley Hills Books, 2000.

Pence, Gregory E. *Who's Afraid of Human Cloning?* Lanham, Md.: Rowman and Littlefield Publishers, 1998.

Rolston, Holmes, III. *Conserving Natural Value.* New York: Columbia University Press, 1994.

West, Michael. *Testimony of Michael D. West, Ph.D. on behalf of the Biotechnology Industry Organization.* Hearing before the Subcommittee on Health and Environment of the Committee on Commerce House of Representatives, 12 February 1998. Available at the website, <http://www.advancedcell.com/testimony-index.asp>.

Endnotes:

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4. Lande, Russel. pp. 12-17.

5. Rolston, p. 5.

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Author's note: *I am truly grateful for the time and thought that Kathryn M. Rodriguez-Clark, Holmes Rolston, III, and Don Sparling put into their answers, exploring by dialogue these ethical issues that confront us.*

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*GENE*RATIONS, *GENE*SIS, AND *GENE*TICALLY ENGINEERED PLANTS: FALL AND SALVATION NARRATIVES THAT QUESTION THE GOODNESS OF CREATION

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As salvation and fall narratives predominate the arenas of both theology and biotechnology, the author presents here an exploration of the ethical and ecological implications of such narratives as they aim to moderate the relationship of human beings to God, Earth, and each other. There is real evidence for concern over the ecological threats created by the genetic engineering of plants. The "feed the world" biotech salvation narrative might not save humankind from starvation, as it glosses over its own form of idolatry, namely, the worship of the market God. What sort of goodness can be found in or made of "creation," one might ask, while pondering the problems and potentials arising out of two competing models for ethics, that of Prometheus and that of Gaia.

> Lastly I would address one general admonition to all, that they consider what are the true ends of knowledge, and that they seek it neither for pleasure of mind, or for contention, or for superiority to others, or for profit, or fame, or power, or any of these inferior things; but for the benefit and use of life, and that they perfect and govern it in charity. For it was from lust of power that the angels fell, for lust of knowledge that men fell, but of charity there can be no excess, neither did angel or man ever come in danger by it.
>
> —Francis Bacon[1]

> The Earth is at the same time mother…
> She is the mother of all
> For contained in her
> are the seeds of all
>
> — Hildegard of Bingen[2]

If one believes a divine power has authorized the radical and spontaneous freedom involved in evolution, through billions of years of slow self-organizing development of plant and animal generations, human beings have recently been countering this creative diversification. Through a habit of dis-creation, our species has presided over the rapid decimation of wilderness, and the erosion of genetic and biodiversity. Unlike the God of Genesis, idolatrous gods of biotech, many fear, are being worshiped through human greed alone. In this paper, I will examine how biotechnology is driven by the unyielding power of a market that exploits and threatens the interconnected generations of creation.

My use of the term "generations" comes from "the generations of heaven and earth" in Genesis 2:4. I propose this term, "generations," as a metaphor to represent the Earth's multiple forms of plant and animal life; it is a term that includes birds and ferns, insects and people, in their evolution through time. In a dialogue with science theorist Donna Haraway, theologian of science Ted Peters, Christian ethicist Max Stackhouse, and eco-theologian Sallie McFague, I will examine different strategies for theorizing about biotech "fall and salvation" narratives. The book of Genesis provides a symbolic backdrop for this examination that, I will argue, discloses the magnitude of earth-threatening forms of genetically modified plants and the importance of theological ethics in challenging corrupt aspects of biotech industry and its science.

The market as God

In *Modest Witness @ Second Millennium*, the feminist historian of science, Donna Haraway, emphasizes how technoscience is hinged on a "narrative set up of threats and promises"—"fears and certainties of disasters" as well as "dreams of progress" that "promise the fulfillment and restoration of human nature."[3] This narrative of threats and promises can be found on Monsanto's webpage that quotes Ismail Serageldin of the World Bank:

> Biotechnology could be a tremendous help in meeting the challenge of feeding an additional three billion human beings, 95% of them in poor developing countries.[4]

Monsanto's "feed the world" propaganda portrays the promise of a Western technological fix for the resource threat of overpopulation.

Using the Marxian troupe of commodity fetishism as a model, Haraway proposes that genetic technology is "...endemic to capitalist market relations...[as] genes displace not only organisms but people and nonhumans of many kinds as generators of liveliness."[5] As an example of the displacement process, Haraway highlights sociobiologist Richard Dawkins' construct of the body as a vehicle through which the gene replicates and transports itself. Haraway explains:

> Mere living flesh is derivative; the gene is the alpha and omega of the secular salvation drama of life itself.[6]

She claims that "fetishes literalize and so induce an elementary material cognitive error. Fetishes make things clear and under control."[7]

I have found this sense of control to be evident in the agricultural Biotech mantra, "We will feed the world." The material cognitive errors in this logic, however, become revealed by the evidence. Released in July 1999, a USDA Economic Research Service Study of major transgenetic crops found that these crops, contrary to manufacturers' claims, did not show any improvement in yield or a reduction in pesticide costs compared to conventional crops.[8]

The genetic map, when fetishized, becomes what Haraway calls a "god trick," by which it gives the scientist or capitalist a "kind of clarity" or "uncontaminated referentiality."[9] Haraway reminds us that a gene is not a thing in itself. One too often forgets that bodies emerge along "webs of integration."[10] This fetishism rings of the old and persistent problem of a Newtonian lens that objectifies matter as composed of passive and isolated entities. In gene fetishism, genes are mistaken for things to which actions might be applied, while their wider ecosystemic interactions are ignored.[11] In biotech agriculture, the genes might well be considered agents, but they are defined only narrowly in regards to the one engineered effect. One gene is described by Monsanto as being "modified to control the lepidopteran family of insects," or another as having "tolerance to Roundup® herbicide."[12] The broader ecosystemic effects of such genetic modifications, unacknowledged by Monsanto's gene fetishism, will be discussed below.

The gene fetish must also be understood in terms of market reductionism. Theologian Harvey Cox, in his article, "The Market as God," finds the following:

> ...a willed-but-not-yet achieved omnipotence of the Market [where] there is no conceivable limit to its inexorable ability to convert creation into commodities.[13]

Cox describes this as the reversal of eucharistic Transubstantiation, when bread and wine become holy. The "Mass of the market" takes the land once held sacred as "Mother Earth, ancestral resting place, holy mountain, enchanted forest, tribal homeland, aesthetic inspiration...," and transforms all these complex meanings into one: real estate.[14]

As the commodity, the gene alone becomes the source of value, creating complex "mistakes, denials, and disavowals."[15] Cox includes the sacred as one of the many denials. Haraway analyzes the denials in terms of Whitehead's fallacy of misplaced concreteness:

> [G]ene fetishists mistake the abstraction of the gene for the concrete entities and nexuses.[16]

This misplaced value is seen operating in the feed-the-world rhetoric. This is another fallacy of misplaced concreteness that does not thoroughly represent the complexities involved in the issues of hunger and overpopulation. A United Nations study done by the Food and Agriculture Organization (FAO), released in April 2000, intentionally excluded any so-called agricultural benefits of genetic engineering from its study because of "ambiguities over the long-term promise, safety and consumer acceptance of this technology." Without studying the potentials of genetically engineered food, the FAO nonetheless found that "growth in global agriculture should be more than sufficient to meet world demand" of a population that will reach eight billion by the year 2030.[17] This statistic stands in firm opposition to Monsanto's alarming claims of a future food crisis.

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Mistakes and denials arise in any technology, but the oversights made by corporate claims on the genetic engineering of plants are not the kind of mistakes that arise out of in-depth studies that include the social, technical, organic, and non-human implications. Too few unbiased (non-industry) scientific studies have been done of the risks of biotech transgenetics, for instance. Blindly plowing forward, as the industry has been, into reconfiguring genes across species boundaries is a radical move, considering the history of evolution. Plant physiologist, Celia Dean-Drummond, explains the tremendous difference between genetic engineering and normal evolution:

> The ability to move sections of genetic material from one highly evolved species to another is an impossibility in the course of normal evolution.... [M]ost species emerge over a period of a million years, with only a handful taking less than 5000 years.[18]

Through genetic engineering, the process has been sped up, now taking a matter of years, or even months.[19]

Are agro-biotech industry scientists being loyal only to the "market god" and their paychecks? Is this what creates acts of ethical irresponsibility in the biotech corporate arena? In the case of Bt corn, with, for instance, its threat to the Monarch caterpillar, Monsanto scientists remain strapped in a position to convince the public of biotech salvation. They stand upon a vast array of denials. Despite numerous studies confirming Monarch toxicity, Monsanto still denies any real threat to the Monarch.[20] They also fail publically to report or even to consider the evidence of depleting effects that Bt has on groundsoil and its harm to other beneficial insects.[21]

The social context of the scientist produces the type of study and the ethical focus. For instance, Novartis scientists are critiqued for doing only inside-lab experiments and turning a blind eye to the vast environmental impacts of Bt. Angela Hilbeck, from the Swiss Federal Research Station for Agroecology, on the other hand, felt it of import to do a study on the effects of Bt on beneficial insects. She found that "lacewings died after eating cornborer caterpillars" who had eaten the Bt toxin. Hilbeck's study indicates the likelihood of the detrimental effects extending up the food web to insect-eating birds.[22] Seemingly anthropocentric in its ethics and prey to the pressures of market reductionism and gene fetishism, Novartis has been charged with denying other realities: unintended effects on insects, birds, and other animal species; dosage and form of toxin; and effects of season and plant growth cycle on the time of toxin's release.[23]

Most industry scientists cite their good intentions to justify their work: they believe Bt will decrease the harmful effects of chemical pesticide use, or they honestly aim to benefit humanity with increased agricultural yields. However, as has been seen, non-industry studies have strongly challenged these positions.[24] Though industry scientists perhaps intend their work for the betterment of life, the market is not a patient entity; and patience is what is needed to limit potentially devastating effects, those unintended consequences that such engineering threatens to release. Ecosystems might benefit if industry science respected the Precautionary Principle:

> [W]hen an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effects relationships are not fully established.[25]

The Precautionary Principle has not been heeded in the production of Bt crops, Roundup-Ready plants, and especially in the application of "terminator" technology—the latter clearly being a technology of market idolatry. Monsanto reverses the message of Genesis 1: "plants and fruit with seed in it." Through its "terminator" technology, plants without the sUed have been created, not to satisfy consumer pressure, nor to feed the world, but to create a sort of double monopolization of production by usurping the productive capacity of both the plant and the farmer.

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The market-god drives the agricultural biotech engine in other ways. For instance, as Celia Dean-Drummond has found

> ...more money has been spent on the development of strawberries that can withstand frost conditions for the spring USA market than on improving the yield of basic sustenance crops, such as cassava, maize or bean plants in the Third World.[26]

Agribusiness biotech's construction of itself as salvific for humanity falls apart as more and more of its clever inventions serve only the commodity fetish. Harvard professor Richard Lewontin, one of the America's leading geneticists, puts its bluntly:

> [T]he feed the world propaganda misleads the public by calling attention to world hunger then using transgenetics not to solve the problem of world hunger but to solve the problem of profit hunger.[27]

Sin, fallen nature, and biotech salvation

In his book, *Playing God: Genetic Determinism and Human Freedom*, Ted Peters introduces a theological ethic that aims to avert the dangers of biotech. For Peters, sin is an estrangement from God, involving an alienation from other people, the self, faith and love. Peters looks to Marjorie Suchocki's use of Whiteheadian "relational metaphysics" for a conceptualization of sin. It affirms that we are internally related to both our DNA and our environment.

> [S]in takes the form of violence that contributes to the ill-being of any aspect of creation, to other people or other creatures or even to planet Earth itself. Sin is rebellion against creation, and thereby, indirectly, rebellion against God.[28]

In this model, sin is mediated through relational structures such as social inheritance. Peters also considers how sin might be genetically determined in the form of selfish genes or violent genetic predispositions and likens this to the Pauline notion of sin transmitted through the flesh. So, he suggests a two-factor determinism, biologically and socially transmitted sin. Despite being determined by DNA and social relationships, human beings nonetheless have the freedom, Peters argues, to resist the determining agents, being "response-able" creatures.[29]

I find Peters' application of Suchocki's construction of sin to biotech ethics helpful for examining the problem of biological pollution and market idolatry. For instance, in cases such as the production of Bt plants, where biotech science contributes to the "ill-being" of insects such as lacewings and ladybugs, on up the food chain to their predators, might the genetic engineering of these particular plants a be considered a rebellion against God in its danger to creation? As Bt is passed on into the ecosystem through pollen and animal ingestion, the sin becomes embodied in the organic ecosystem and reproduced. As far as Monsanto and its scientists fall prey to the greed and profit motive of the market system, they participate in an idolatry of the market that overlooks the integrity and health of God's creation. The economic system in this sense harbors the corporation's socially transmitted sin of greed that disseminates a biological sin (Bt) into the fabric of Earth's ecosystems.

Christian ethicist Max Stackhouse also conceives of sin as both moral and natural. In his paper, "Ethical, Religious, and Cultural Reflections on the Engineering of Nature," Stackhouse defines ethics as the move to make things work "better." However, this definition depends upon a view of nature that is "less than perfect, not fully living up to potential, and constantly subject to breakdown, is called 'sin,' which is not so much an action as a condition."[30] Stackhouse recalls the sociological analysis developed by Max Weber, and used by R. K. Merton in his analysis of Protestant attitudes that have driven science in its "study of Nature" for "the greater glory of God and Good of Man."[31] While nature beholds the Creator's "order of things," nature has also been considered disorderly and in need of "reordering that could conduce it to 'good in the light of the Doctrine of Salvation'…."[32]

This view about science and technology supports the construction of a technological salvation rooted in the notion of the doctrine of the Fall. Stackhouse refers to the work of David Noble in *The Religion of Technology*. Noble argues:

> [T]he…project of Western technology…is actually medieval in origin and spirit. […] [It] was rooted in an ideological innovation which invested the useful arts with a significance beyond mere utility. Technology [was]…identified with transcendence, implicated as never before in the Christian idea of redemption. […] The other-worldly roots of the religion of technology were distinctly Christian.[33]

Stackhouse agrees with the view that technology can be used by the just for the world's salvation. In other words, the "wisdom and virtue God implanted in humans with the gift of the image of God" can only be possible "after the Fall."[34]

Following the tradition of the Epistle to the Romans,[35] Stackhouse believes that nature was created good, but fell. He writes:

> Disease and plagues wreak terrible havoc on life, and humans by nature are inclined to rearrange their environments to suit themselves even if it threatens whole species.

Stackhouse believes that nature has then departed from "the intent of 'creation,'" from an "intended order that is not perfectly manifest in the way things are." He continues:

> The fact of goodness means that residual capacities to improve life are present; the fact of falleness means that improvement is required, two facts that seem to survive in critical, post-literalist readings of the creation myth. The disciplined use of technology, under God's watchful eye, in this view, is a grace-filled means whereby residual if ambiguous goodness can make things that are distorted better. In this view, engineers are the physicians of fallen nature and the artisans of a better world, if they view their work under God's guidance.[36]

Although every theologian and theorist considered here participates in the journey for a "better world," the good path remains disputed. In this world where what might be called the "sin of anthropocentrism" predominates, why does Stackhouse then need to deem nature "fallen"? Apparently influenced by an aspect of the tradition that Rosemary Radford

Ruether defines as a "quasi-gnostic" depreciation of nature,[37] Stackhouse applies modernist science to "fallen" nature, giving him some sense of salvific hope in human technology. I do not deny that technology can be healing. But, to predispose technology on the view of a "fallen" earth places the source of salvation as human technology. It forgets that the greatest danger to the good and healing powers of creation, to both humanity and the other generations of earth, is not nature itself, but human violence against nature through technological innovations.

"The fact of goodness" can also mean that creation, as it has evolved over billions of years without human technology, harbors a deeper-than-human wisdom of healing, considered by some to be the *logos* of God, and this must not be overlooked in the path toward a better world. For undomesticated animals, a better world might be one without human technology; for some human beings, a better world means human technology. For God, who created both, a better world might very well involve the best for both, a compromise that I am not sure Stackhouse takes seriously. Human judgement of nature as fallen has created technological travesties and the scientific neglect and abuse of nature. The view of nature as something fallen that needs to be fixed (as if non-human creation wasn't good enough), I believe, participates in what Ruether calls "an earth-fleeing ethic, which has undoubtably contributed very centrally to the neglect of the earth, to the denial of our commonality with plants and animals...."[38]

If God guides biotech scientists, as Stackhouse claims, then which God? If not the Market God, then which God? If Stackhouse means the God who seeks well-being for all of creation, and I suspect he does, then how can the technologies of agribusiness biotech examined above be found under God's guidance?

Prometheus and Gaia

A comparison of Stackhouse's position with the similar but significantly different argument of Ted Peters will be critical. The scientific attempt at mastery of nature is theorized by what Ted Peters calls "Promethean determinism." For Peters, human creativity, such as that of biotech, is a power of co-creation; but he makes it clear that this creativity does not make human beings into gods.[39] Peters reconstructs "playing God" through what he calls "Promethean determinism," based on the image of a "controlling God." Similar to the kind of clarity produced by Haraway's god-trick, in Peter's words, "promethianism tries to play God by taking God's place, by taking control."[40] However, for Peters, this is a false sense of domination, in the case of biotech science.[41]

To the contrary, Peters also constructs Prometheanism as potentially salvific:

> "Prometheans could determine a future that would bring better health and increased well-being to the whole of the human race.[42]

However, he also issues a warning:

> [Notice] the gene myth's implicit prometheanism: As Prometheus stole the secret of fire from the gods, we will steal the secrets of life from DNA.... Once we can have the knowledge, we will have the power. And with this power we can do what? Yes, we can do damage beyond measure....[43]

As shown above, Peters' discussion of sin proves helpful in the biotech ethical dilemma. His support of genetic engineering, however, is oddly based on a desacralization of nature.

Peters constructs his position in conflict with Jeremy Rifkin, claiming Rifkin's resistance to genetic engineering as based in "vague naturalism, where nature itself claims sacred status."[44] For Peters, nature is not sacred; God is. A sacralization of nature, for him, reduces God to the level of enzymes, viruses, and sexual reproduction. Peters mounts a stout defense against the idolatries of genetic determinism and material reductionism. Biotech dangers to ecology adhere to additional idolatries, examined above—gene fetishism and market reductionism. Worship of the power of one gene, for profiteering, creates the denials of moral conscience observed in some practices of biotech science. However, the reductionist problems of genetic determinism do not necessarily evoke a sacralization of nature as a whole, as Peters assumes.[45] I also do not share Peters' fear that the wider view—that Earth as a whole is sacred—can only warrant a ban on genetically based medicines.

It is interesting that Peters critiques human attempts of control over nature while simultaneously putting on the mask of Prometheanism himself, in the case of biomedical research. The biotech salvation narrative compliments his image of a transcendent God that promises to bring about the new world, where there shall be "neither sorrow, nor crying, neither shall there be any more pain" (Rev 21:4). The model of an otherworldly divinity has been widely critiqued for the dilemma of Christian alienation from and devaluation of the body. As Jürgen Moltmann puts it, to distinguish between God and the world "surrenders the world, as godless, to its scientific 'disenchantment' and its technical exploitation." Instead, Moltmann discovers "God in all the beings he has created," and finds God's "life-giving Spirit in the community of creation that they share."[46]

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Peters does advocate caring for other animals, but he does not consider that the human benefit of biotech pharmaceutical innovations entails a cost to animal habitats. Plants are to be used as pharmaceutical factories in the production of drugs.

> Foraging animals, seed-eating birds, and soil insects will be exposed to a range of genetically engineered drugs, vaccines...and hundreds of other foreign substances for the first time, with untold consequences.[47]

Stackhouse elaborates on Peters' model of Prometheanism. Like Peters, he rejects the sacred-Earth model, Gaia. These two topics are introduced as one. Stackhouse claims the two competing salvation narratives in the West are Gaia and Prometheus. Prometheus is described as stealing the power of technology from the gods, making the gods dispensable. Human beings claim divine power by surpassing the mythical deities. Gaia is described as the myth where the Earth is sacred Mother, who can heal herself if left alone, despite "wayward offspring" whose technology resists her "natural wisdom."[48] Stackhouse uses these Greek models to expose "those forms of technology that have lost sight of the actual roots of what drives contemporary theology."[49] He sums up the issue as a conflict between the Gaians, who aim to limit technology by paying more attention to ecology, and the Prometheans, who seek to "seize control of our own evolution" and expand technology so nature bends to human will. Stackhouse maintains that "in either case we have no trans-natural or metaphysical guidance as to what kind of morality might guide us."[50]

Stackhouse constructs his position from his historical narrative. Though the foundations of modernity involved a belief in "a divine wisdom, a deep, ethically ordered *logos*" framing the empirical world, the *logos* lost "any kind of religious or ethical a priori."[51] Stackhouse calls this "the enthronement of Nature in modernity." Emptied of a righteous God, the natural theology described by Stackhouse ascends as "Mother Earth" or as a morally neutral source, reverting to what he calls "a pagan world where barbarism was quite conceivable, now with technology as our flint."[52] Stackhouse believes that the two movements, "sovereignty of Nature" and the "sovereignty of History," have given standards extrinsic to natural, and cultural norms for moral choice of good or evil; and they propel moral atrocities such as the eugenics of Nazism and Stalin's ecological disasters.[53]

Though modernity did lose a "religious or ethical a priori" and created morally atrocious technologies perpetuated by the Nazis and Stalin (and the United States, in the developments of nuclear technology), I strongly disagree with Stackhouse's assumption that honor for "Mother Earth" is to be blamed for these atrocities, including his labeling of modern industrial evils as "pagan barbarism." In this section of his paper, Stackhouse's agenda against "evil" becomes conflated with a rather disturbing need to attack what is "pagan," interpreted by many to mean "earth-revering," and it recalls a form of "Christian barbarism," the persecution and hatred of "other" religions. Though the history of the word "pagan" is too complex to address here, Stackhouse's use of it is reductionist and dangerous. In the words of Ed McGaa, Eagle Man, reverence for Mother Earth means "healing the harms done to Mother Earth."[54] In McGaa's assessment, modern industrial technology has been ravaging Mother Earth, not worshiping her. I believe that Stackhouse, in equating the destructive tendencies of modern science with "pagan" or earth-revering perceptions, has mixed up Prometheus with Gaia, as if Promethean behavior has revered Gaia. The evidence is quite the contrary.

I believe that Stackhouse, in equating the destructive tendencies of modern science with "pagan" or earth-revering perceptions, has mixed up Prometheus with Gaia, as if Promethean behavior has revered Gaia. The evidence is quite the contrary.

Numerous works examining the process of modern scientific disenchantment explain a Christian conceptual influence. Confirming Stackhouse's position, Francis Bacon ties the scientific revolution to ideas about the fall and redemption. With Eve's sin, "nature fell out of man's control," but for Bacon the fall can be reversed through science, restoring nature to humankind's dominion.[55] Under scrutiny in the scientific laboratory, nature is put to the test and "forced to yield *her* secrets."[56]

Bacon likens the Inquisition to the scientist's technique of investigation: "disclosing the secrets of nature" by "entering and penetrating into these holes and crevices."[57] Without any apparent intention, Ted Peters seems to be paraphrasing Bacon as he ends his book, *Playing God*, with this comment on biotech research science:

> Probing the mysteries of the natural realm and becoming privy to her magnificent secret is in itself a worthwhile vocation, needing no additional moral confirmation.[58]

Does "her secret" not also deserve the potential for freedom from penetration? Does any creature have a right *not* to be probed? Might the generations of life have some integrity that would appreciate protection from biotech invasion? Once genetically manipulated, the change can be passed on in the web of life, hardly the "amoral" action that Peters suggests.

Another orthodox Christian scientist, René Descartes, constructed the model of nature as machine, empty of sanctity and empty of life itself. It has been argued that this mechanistic view is still one problematic in genetic engineering, a science that, when market-driven, "glorifies efficiency," the optimal trait of machines. Genetic engineers aim to make living beings "more efficient." This is based on capitalist ideals that exclude feelings of empathy and love from the picture.[59] In other words, it is harder to empathize with a machine.

Hence, Peters' desacralization of nature seems familiar. Both he and Stackhouse adhere to the age-old Christian anxiety and denunciation of earth-inspirited belief systems. They assume that a sacralization of nature means that Earth, if viewed as holy, cannot be altered by human technology, as if a "sacred Earth" would somehow mandate a ban on biotech. However, it has been argued by Carolyn Merchant that historically, the model of nature as a living organism, or as the dwelling place of spirit(s), has indeed promoted more accountability and restriction to technologies. For instance, miners of the 15th and 16th century believed the mines to be the womb of Mother Earth. This did not stop them from mining, but it made them ethically accountable for limiting the destruction of their mining practices.[60] Another reference to the notion that a sacred Earth is a protected Earth can be found in Isaiah 11:9:

> They shall not hurt or destroy in all my holy mountain, for the Earth shall be full of the knowledge of the Lord.

Gaian ethics

The notion of Spirit in nature, familiar to indigenous peoples, is not foreign to the Judaic and Christian tradition. The Earth viewed as both a *living organism* and as *embodying Spirit* can be found in Genesis. *Ruach* (Spirit) is the Hebrew term for breath and wind (Genesis 1:1). The earth is also depicted as alive and having the power to birth forth the plants and the animals (Genesis 1:11-12). Making scientific technologies accountable to the perception of a sacred Earth does not necessarily mandate an outright ban on biotechnology, as both Peters and Stackhouse fear. It does, however, make the science answerable to the sacred when "probing" its mysterious body. Perhaps it would justly mandate a ban on those genetic engineering practices that obviously threaten the livelihood of ecosystems and their plant and animal species, such as in the cases of Bt and "terminator" technology.

To come to more clarity about an appropriate theological ethics that might guide biotech morals, the model of Gaia should be considered. Gaia, the term for the Greek Earth Goddess, has been revived by contemporary scientist James Lovelock to describe Earth as a living system, as a single, living organism.[61] Ruether, in her book, *Gaia and God*, claims that God need not be simply replaced with Gaia as a focus of worship.[62] As I examined above, the notion of a living and sacred Earth is familiar to the Judaic and Christian traditions. "The biblical God and Gaia are not at odds" but co-mingle with each other.[63] Immanent theologies have been developed in the panentheisms and ecofeminist theologies that explore the world as indeed God's body.[64] Belief in "the divine" as rooted in the universe can guide an ethics of deep love and care for Earth.[65] In light of the model of Gaia and in contrast to Peters and Stackhouse, Ruether claims that nature may be reshaped, guided by human ideals.

> But this reshaping is finally governed by the finite limits of the interdependence of all life in the living system that is Gaia. Ecological ethics is an uneasy synthesis of both these "laws": the law of consciousness and kindness, which causes us to strain beyond what "is," and the laws of Gaia, which regulate what kinds of changes in "nature" are sustainable in the life system of which we are an inextricable part.[66]

The perception of a sacred Earth calls us to understand human participation in divine immanence.

"Playing God" becomes a problematic phrase in this discussion. Again, which God? In the case of the Promethean attempt at the domination of nature, "playing God" becomes a destructive form of anthropocentrism, as it does not recognize or respect the intricate webs of life with their multiple species of beings. Prometheus is modeled on a God that objectifies the Earth; it is an overly transcendent God that cannot speak to questions of cosmic incarnational immanence. However, there is a tradition in Christianity that allows human beings to attempt to be Godlike in another way.

Playing with the sacred

Peters emphasizes that "science should serve technology" in responding to the "needs of the neighbor" to provide greater well-being and "make life qualitatively better for God's creatures."[67] Stackhouse, too, asks whether genetic engineering can live up to "righteous or holy living, and thereby contribute to the common good?"[68] Stackhouse believes righteous technology must work to make things "better." How might this happen in biotech?

Instead of playing God, biotech scientists might benefit the common good by the realization that they are playing with the sacred, the world as God's body, an incarnation of God. Under this model, "to play with" the sacred reality is not "bad" in itself; but when human sin becomes involved, as modeled above by Suchocki, an alienation from God that involves an alienation from love for the neighbor takes over. I believe this is what happens in the market-God model, when biotech is corrupted and narrowed in its study by capitalist systems of money-making. The "institutions, laws, and bodies of market capitalism" have become collective forms of sin,[69] creating unnecessary forms of Earth-exploitative biotechnologies.

As long as humanity is the only neighbor that is considered worthy of love and prosperity, the generations of heaven and earth will continue to fall—not into sin, but into extinction wrought by human technologies of sin.

Sallie McFague offers an alternative theological ethic that challenges the dangers of "playing God" in the Promethean way. She offers Jesus' life as a prototype for an ethics that emerges from deeply loving God and, hence, loving "all living things."[70] Acting with this creation-loving ethic is what McFague calls "deification" or *theosis*:

> [Deification is] a reflection of God's life and an attempt to become like God through loving the neighbor in all creatures. Similarly, Peters calls for "proleptic ethics" as the "most practical to love the neighbor in light of a better future.[71]

For McFague, sin involves selfish accumulation of money, fame, power, and consumer goods. Salvation through deification evokes a sense of consciously caring for the community of creation, loving one's neighbors, loving God by emptying the self and detaching "from distorted goods (money, power, fame) allowing for attachment to genuine goods (God, other people, the natural world)."[72]

As seen in the genetic engineering of plants, the capitalist sin of greed too often moves biotech science to anthropocentrist and corporate interests that harm Earth's habitats and creatures. Consider another example. Transgenic trees and forests are being created in labs at the University of Washington's Poplar Molecular Genetics Cooperative, the Oregon State University's Tree Genetic Engineering Research Cooperative, and the Institute for Forest Genetics in Placerville, California. Who is supporting this research? Those cutting down western forests: Alberta Pacific Forest Industries, Champion International Corporation, Georgia-Pacific West, Inc., Inland Empire Paper Company, Scott Paper Ltd., Shell, and National Forest Service are a few of the institutions generating this research.[73]

What is the goal for these institutions? More efficient forests, such as new cottonwood trees that grow 10 feet a year. Ecologist Jack Turner observes:

> Our ideas of "health," "disease," "improvement," and "diversity" are being modified by the concept of efficiency for the sake of greater profits. Transgenetic forests are not about health; they are about money.[74]

Research has focused on herbicide resistance, and resistance to insects and disease. The herbicide glyphosate (Monsanto's Roundup), when sprayed on a forest, will kill everything but the genetically engineered trees.

> Roundup is the third most commonly reported cause of illness among agricultural workers in California. [...] [It] blocks nitrogen fixation in plants, harms fungi, reduces winter hardiness in trees, and retards the development of earthworms. Do we want this stuff sprayed on Western Ecosystems?[75]

Also, Bt is the first choice for a biological pesticide to apply to these trees. Recall that Bt is famous for killing both monarch larvae and other beneficial insects. It is carried by the wind through pollen. Turner asks two key questions:

> Aren't those beetles, butterflies, caterpillars, fungi, rusts, borers, and worms somebody's lunch? Weren't genetic engineers required to study ecology at some point in their education?[76]

The alternative type of transgenetic forest being explored is the "sterile forest," composed of "terminator trees," which are not able to reproduce. Ironically, these forests are described by biotech as "healthier, improved, more efficient."[77] For whom?

There is a deep-seated dissociation from the earth involved in this story. According to environmental historian Wes Jackson:

> At one point in our evolutionary history...our ancestors considered themselves to be part of the natural world, and they were able to experience their surroundings directly and immediately. Humanity's fall from grace came about when nature began to be regarded instead as an object, foreign and manipulable. Such is our present state of affairs in which "the environment" or "wilderness" is regarded as something out there to be "saved" or "preserved" by one clever invention or another.

For Jackson, evil is "the wanton manipulation of this "other" in order to serve one's self-aggrandizing ambitions—and in the current economic system in the U.S., this means "exploitation for profit." He suggests that this is a variation of the old Augustinian idea of concupiscence, or "wanting to have it all."[78]

Ian Barbour, in *Ethics in an Age of Technology*, takes a similar position to that of Jackson. He does not advocate a mandate against biotech per se, but a strong ethical direction for it.

> [Human beings] can be coworkers with God in the fulfillment of God's purposes.... At the same time, the biblical tradition speaks of human sinfulness and our tendency to use power to advance self-interest at the expense of others. This tradition is the unbridled drive for mastery and control, and it rejects all attempts to seek technical fixes as a substitute for changes in human relationships and institutions.[79]

Science might benefit from an ethic of love for all creaturely neighbors. As Barbour puts it:

> I do hold that we must not treat creatures as mere commodities to alter and use for our own benefit.... [I]n place of the anthropocentric and technocratic assumptions expressed in our domination of nature, we should encourage a greater respect for all living beings.[80]

John Cobb and Charles Birch use an organismic model of ethics, similar to the Gaia model, where every being is constituted by interaction with the world. All beings are subjects participating in continuity and novelty. The organismic view is given by the sciences of ecology and biology. Similar to the Gaia model, this model houses an ethics that avoids anthropocentrism. Concern for the nonhuman brings a richness of experience. God is the source of this creative-responsive love.[81]

As most of the genetic engineering of plants has been driven by the greed of the profit motive constructed by global capitalism, several questions remain: How can the genetic engineering of plants work toward worldly salvation, if it is being driven by gene fetishism and market idolatry? Who is "fallen" in this picture? Nature, or human nature? I have examined how the construction of a "fallen nature" can too easily serve Promethean technologies of destruction. Conceiving "fallen human nature" however, remains crucial for theological ethics. It calls for responsible resistance to human created evils that compromise the health of earth's ecosystems. As long as humanity is the only neighbor that is considered worthy of love and prosperity, the generations of heaven and earth will continue to fall—not into sin, but into extinction wrought by human technologies of sin.

Conclusion

Concerning theology, Haraway suggests we can learn to live without salvation narratives.[82] I opt instead for a salvation narrative that highlights the diverse generations of creation. In the words of Wes Jackson, "Nature's wisdom must have priority over human cleverness," that earth may be a place of hope and not exploited.[83] Human beings were created after the plants and the other animals in both Genesis and in the book of Evolution. However, we still have not learned our lessons from our earth ancestry and its indwelling creative *logos*. In this sense, we are far from the neighborly love in *theosis*. We do not honestly seek to love, understand, or protect the needs of nonhuman creatures, with a few exceptions.

For McFague, the problem with the capitalist economy (and I believe, the science produced by it) is that it aims to eradicate what it sees as the natural enemy, that is, anything threatening its profit motive. The industry scientists genetically manipulate plants to overcome whatever gets in the way of highly efficient production of the plants for human commodification. For instance, insects and other non-commercialized plants (so-called "weeds") are natural enemies. The industry also promotes its salvific position against other social evils, starvation and chemical pesticides and herbicides. Again, as I have explored, evidence abounds to refute the misplaced concreteness in the "feed the world" and "freedom from chemical pesticides" propaganda advertizing the "goodness" of the industry.[84] This is a perception of fallen nature constructed by commercial capitalism.

If salvation is about making "goodness" on earth, then whose idea of goodness? For Stackhouse, goodness seems primarily to involve human release from suffering. But, human well-being completely depends on the well-being of Earth. It should be additionally recognized that the way the generations were created mandates some suffering.

> What is good for the mosquito is not for the naked arm. The heart transplant that saves my life comes at the cost of another's life.... [T]his is just the way things are. If we want a world in which nothing bad happens to any person, tree, or elephant, then nothing could happen at all.[85]

If Stackhouse and Peters believe that biotech can save by changing the so-called "falleness" of nature into a world with no more crying, McFague affirms the suffering aspect of nature. Humanity needs to accept its limits.

> God is the belief that hope and not despair, life not death, laughter not tears are deep in the nature of things and that while despair, death, and tears are a necessary part of reality...they are not the dominant part.[86]

For McFague, to bring goodness into reality is to respond to the call of the oppressed, which now includes all the generations of creation being exploited by the moral gaps in the current economic system.[87]

Since every technology involves a cost, Cobb and Birch suggest that the development of new technologies must honestly "estimate as far as possible the cost" and then "decide what price we are willing to pay."[88] Ethics mandates that the probable benefits outweigh the costs of the technology. The risks involved in agricultural biotech are clearly evident for animals and ecosystems and this will also directly diminish human quality of life. The anthropocentric and profit-driven priorities of industries that pay homage to the market-god promote benefits that ride upon denials of ecological harm. Again, this could change if the precautionary principle is enforced in commercial decision-making.

Theologian Catherine Keller, in her article, "Playing God," agrees that biotech science must face up to the ethical challenges involved in the commodification of life. Indeed, we as creatures are going to alter the shape of creation, but we have a "godlike" responsibility to make "good" for all creatures. As did Stackhouse, Keller believes we can take delight in the goodness involved in the "intensive sense of the common."[89]

We may look to Genesis, as it encourages the earth's capacity for creation, and the diverse forms of plants with their ability to pass on their own seed, DNA and all, to countless generations. The subjective ability of plants to reproduce and cross-pollinate, is something that cannot be monopolized. Vandana Shiva reminds us:

> Living organisms, unlike machines, organize themselves. Because of this capacity, they cannot be treated as simply "biotechnological inventions" or "products of the mind" that need to be protected as "intellectual property."[90]

Patenting control over the gene, or the crop, has its limits. Once the gene is spliced, the change can be passed on into the web of life, unmonitored, invading organic neighboring crops as well as wild ecosystems. Technoscience threatens to create super invasive weeds, resistant to herbicides, pests, and viruses, further decimating the already dwindling biodiversity of Earth.

Earth brings forth plants of every kind. They all are good, but now disappearing. A vast multiplicity of plant species are becoming extinct due to industrial agriculture's green revolution and the biotech perpetuation of its monocrop agriculture.

> For over three and a half billion years, life has been blossoming, diversifying, and expanding into incredible forms . . . In the space of a human generation we have truncated this flowering.[91]

The salvation and fall narratives of biotech agriculture offers more corporate propaganda than life potential. As long as capitalist concupiscence drives the genetic engineering of plants, it is genetic erosion and pollution, the desecration and extinction of soil organisms, poisoning of water, fish, and birds, that will become fruitful and multiply. As a creation-affirming story, par excellence, Genesis evokes an Earth-centered wisdom that might reroute the ethics of biotechnology, one that magnifies the goodness of ecosystem integrity instead of economic growth.

Certainly the generations of all life, once upon a time, evolved with the earth in common. The God of Genesis enabled the good earth to bring forth plants and fruit with good seed in it. As biotech seeds and pollen now pass into neighboring and future generations, we are compelled to question the goodness of creation.

Works cited:

Cox, Harvey. "The Market as God." Internet document from the website of *The Atlantic*, <www.theatlantic.com/issues/99mar/marketgod.html> (27 Oct. 2000).

Barbour, Ian. *Ethics in an Age of Technology*. San Francisco: Harper, 1993.

_____. *Religion in an Age of Science*. San Francisco: Harper, 1990.

The Bible. New Revised Standard Version, © 1989, Division of Christian Education of the National Council of Churches of Christ in the United States of America.

Birch, Charles, and John Cobb. *The Liberation of Life*. Denton: Environmental Ethics Books, 1990.

Dean-Drummond, Celia. *Theology and Biotechnology: Implications for a New Science*. London: Geoffrey Chapman, 1997.

Deffenbaugh, Daniel G. "The language of the fields: Following nature's lead at the Land Institute." Internet document from the website of *Sojourners*: <www.sojo.net/home/magazine/i...s/issue/soj9509/article/950923.html> (1 Oct. 1995).

Desser, Chris. "Unnatural Selection or Bad Choice." In *Made Not Born: The Troubling World of Biotechnology*, ed. by Casey Walker, 16-26. San Francisco: Sierra Club Books, 2000.

Haraway, Donna J. *Modest_Witness@Second_Millennium.FemaleMan_Meets_OncoMouse: Feminism and Technoscience*. New York: Routledge, 1997.

Hart, Kathleen. "Biotech crops do not improve yield or cut pesticide costs, USDA finds." *Food Chemical News* (5 July 1999): 13-14.

Keller, Catherine. "Playing God." In *Made Not Born: The Troubling World of Biotechnology*, ed. by Casey Walker, 99-102. San Francisco: Sierra Club Books.

Kimbrell, Andrew. "Critiquing the Biotech Worldview." In *Made Not Born: The Troubling World of Biotechnology*, ed. by Casey Walker, 63-73. San Francisco: Sierra Club Books.

Jackson, Wes. "Clear-Cutting the Last Wilderness." Internet Document from the website of The Land Institute. <www.landinstitute.org/clearcut.html> (Fall 1999).

Lovelock, James. *The Ages of Gaia: A Biography of our Living Earth*. New York: Norton, 1988.

McFague, Sallie. *Life Abundant: Rethinking Theology and Economy for a Planet in Peril*. Minneapolis: Fortress, 2001.

Merchant, Carolyn. *The Death of Nature: Women, Ecology, and the Scientific Revolution*. San Francisco: Harper & Row, 1989.

Moltmann, Jürgen. *God in Creation*. Minneapolis: Fortress Press, 1985.

Monsanto. "Environmental Benefits of Crops Developed through Biotechnology." Internet document from the website of Monsanto: <www.Monsanto.com/monsanto/me...nter/background/00mar22_enviro.html> (22 March 2000).

Noble, D. F. *The Religion of Technology: The Divinity of Man and the Spirit of Invention*. New York: Knopf, 1998.

Peters, Ted. *Playing God? Genetic Determinism and Human Freedom*. New York: Routledge, 1996.

Ravetz, J. *Scientific Knowledge and its Social Problems*. Oxford: Clarendon Press, 1971.

Rifken, Jeremy. "Unknown Risks of Genetically Engineered Crops." Internet document from the website of Biodevastation 2000: <http://biodev.org/resourcefiles/rifkin.htm> (7 June 1999).

Roberts, Elizabeth, and Elias Amidon, eds. *Earth Prayers: From Around the World*. San Francisco: Harper, 1991.

Ruether, Rosmary Radford. *Gaia and God*. San Francisco: Harper & Row, 1992.

Serageldin, Ismail. "Biotech Basics." Internet document from the website of Monsanto: <www.biotechbasics.com/why.html> (19 Dec. 2000).

Scharper, Stephen B., and Hilary Cunningham, eds. *The Green Bible*. New York: Orbis, 1993.

Stackhouse, Max. "Ethical, Religious, and Cultural Reflections On the Engineering of Nature." Presentation given at a Gordon Research Conference on environmental engineering, Colby-Sawyer College, New London, N.H. (May 2000).

Shiva, Vandana. *Biopiracy: The Plunder of Nature and Knowledge*. New York: South End Press, 1997.

Turner, Jack. "Modern Forests.." In *Made Not Born: The Troubling World of Biotechnology*, ed. by Casey Walker, 74-79. San Francisco: Sierra Club Books, 2000.

Union of Concerned Scientists. "Update: Ecological risks of engineered organisms: toxic exudates from Bt-corn roots." Internet document from the website of the Union of Concerned Scientists: <www.uscusa.org> (21 Dec. 1999).

_____. "Update: FAO Report: Enough food in the future—without genetically engineered crops." Internet document from the website of the Union of Concerned Scientists: <www.ucsusa.org> (2000).

_____. "Case Study: Roundup Ready Soybeans" Internet document from website of the Union of Concerned Scientists. <www.ucsusa.org> (not dated).

Endnotes:

1. Ravetz, p. 436.
2. Roberts, p. 46.
3. Haraway, pp. 44-45.
4. Serageldin.
5. Haraway, p.135.
6. Ibid., p.133.
7. Ibid., p. 136.
8. Hart, pp. 13.
9. Haraway, p. 136.
10. Ibid., p. 142.
11. Ibid., p. 143.
12. Monsanto.
13. Cox, p. 4.
14. Ibid.
15. Haraway, p. 144.
16. Ibid., p. 147.
17. Union of Concerned Scientists, "Update: FAO Report."
18. Dean-Drummond, p. x.
19. Ibid.
20. See <www.monsanto.com>
21. Union of Concerned Scientists, "Update: Ecological risks."
22. Desser, p. 22.
23. Ibid., p. 23.
24. Union of Concerned Scientists, "Update: Ecological risks" and "Update: FAO Report."
25. Desser, p. 25.
26. Dean-Drummond, p. 82.
27. Lewontin, in Jackson, p. 3.
28. Peters, p. 91.
29. Ibid., p. 93.
30. Stackhouse, p. 3.
31. Ibid., p. 6.
32. Ibid.
33. Ibid., p. 8. Also see Noble, p. 9.
34. Stackhouse, loc. cit.; Noble, loc. cit.
35. Rom 5: 12-21.
36. Stackhouse.
37. Ruether, p. 129.
38. Ibid., p. 139.
39. Peters, p. 15.
40. Ibid., p. 26.
41. Ibid.
42. Ibid., p. 93.
43. Ibid., p. 177.
44. Ibid., p. 14.
45. Despite Monsanto's claims that their genetically engineered crops will alleviate agricultural impacts on the land, the Union of Concerned Scientists explain that risks remain detrimental to ecosystems. "The environmental benefit Monsanto claims for Roundup Ready soybeans is associated with the move away from popular herbicides like atrazine, whose active ingredients persist in the environment. Even granting that glyphosate is less toxic than atrazine and generally to be preferred to it, a switch from one herbicide to another does not result in an environmentally sound agriculture. Glyphosate is highly toxic to plants and fish [and] are dissolved in so-called inert ingredients that can also be toxic. More fundamentally, it is highly unlikely that chemical companies that produce herbicide-tolerant plants will ever develop products that cut into their substantial herbicide revenues.... The bottom line: US agriculture remains shackled to intensive chemical use" (Union of Concerned Scientists, "Case Study: Roundup Ready Soybeans").
46. Moltmann, p. xi.
47. Rifkin.
48. Stackhouse, p 11.
49. Ibid.
50. Ibid.
51. Ibid., p. 13.
52. Ibid., p. 14.
53. Ibid., p. 15.
54. Ruether, p. 96.
55. Ibid., p. 195.
56. Ruether, p. 195.
57. Merchant, p. 168.
58. Peters, p. 178. Peters subsequently qualifies this statement by claiming biotech must aim to make life better for all creatures, a healthy mandate.

59. Kimbrell, p 65.

60. Merchant, p. 41.

61. Lovelock.

62. Ruether, p. 4.

63. Ibid., p. 240.

64. For example, Sallie McFague's *The Body of God: An Ecological Theology* (Minneapolis: Fortress, 1993).

65. Ibid., p. 5.

66. Peters, p. 31.

67. Peters, p. 178.

68. Stackhouse, p. 12.

69. McFague, p. 175.

70. Ibid., p. 176.

71. Ibid., p. 175.

72. Ibid.

73. Turner, p. 77.

74. Ibid.

75. Ibid.

76. Ibid., p. 79.

77. Ibid.

78. Jackson, quoted in Deffenbaugh.

79. Barbour, *Ethics in an Age of Technology*, p. 198.

80. Ibid.

81. Barbour, *Religion in an Age of Science*, p. 136.

82. Haraway, 45.

83. Jackson, quoted in Deffenbaugh.

84. Union of Concerned Scientists, "Update: Ecological risks."

85. McFague, p. 153.

86. Ibid., p. 155.

87. Ibid.

88. Birch and Cobb, p. 233.

89. Keller, p. 103.

90. Shiva, p. 23.

91. Foreman, quoted in Sharper and Cunningham, p. 90.

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Heal Her, I Beseech You: Modern Epidemiology and Prayer for Recovery

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Evidence accumulates in the medical literature that studies conducted in accordance with current clinical epidemiologic research standards support the hypothesis that religious factors can improve health and accelerate the recovery from disease. The most recently published results from randomized trials on the therapeutic efficacy of intercessory prayer are reviewed and discussed in this essay. The author concludes that research ethics can and should include the study of the therapeutic efficacy of prayer to gather the best possible evidence for further research and, most importantly, for the patients' benefit.

> Science has something positive to say about prayer.
>
> —Larry Dossey[1]

Introduction

In 1993, David Eisenberg and his colleagues reported that one out of three Americans used "unconventional" therapies.[2] As reported by the same investigators in a recent follow-up article covering the years 1990-97, "alternative medicine use and expenditures increased substantially ..., attributable primarily to an increase in the proportion of the population seeking alternative therapies, rather than increased visits per patient."[3] Fully 25% of participants of Eisenberg's initial telephone survey had prayed during the previous year for recovery from a specific disease. In 1997, this figure had reached 35%. No other unconventional therapy yielded such a high percentage, most of them ranging from 1 to 3% for remedies such as homeopathy, and from 13 to 16% for relaxation techniques.

In an attempt to answer the question, Is prayer an effective therapy?, the following points need to be addressed: (1) how prayer for healing is conceptualized, (2) whether there exists epidemiologic evidence that prayer heals, (3) the current explanations for how prayer heals, and (4) whether the therapeutic efficacy of prayer can and should be studied, just like any other candidate medical intervention.

Not much in my attempts to answer these questions refers to scientific and religious aspects from outside my personal perspective as an epidemiologist with a Judeo-Christian background. My goal is to contribute to the design of future studies in the wider field of spirituality in medical therapy and causation research, with the health of all in mind.

Prayer for recovery

Two characteristics of prayer are particularly important in our context. Firstly, prayer for recovery[4] is petitionary. The underlying assumption is that God hears our petition and may (or may not) respond by directly acting in the world. Secondly, prayer for recovery can be self-centered (intrapersonal, local, reflexive) or intercessory (interpersonal, distant, non-reflexive). Any attempt to explain the therapeutic efficacy of intercessory prayer needs to explain the distant effects of petition.

Petition

One Christian view is that prayer is "neither the manipulation of God nor just the illumination of our perception, but...the alignment of our wills with his, the correlation of human desire and divine purpose."[5] In petitionary prayer, however, we do attempt to manipulate, by asking God for something. Despite considerable differences among among faith traditions, prayer for recovery from disease plays an important role in both Judaism and Christianity.[6]

While cure is the restoration of bodily or mental health from a disease as defined by current biomedical standards, healing is well defined by Pilch as the restoration of meaning to life. In the epidemiologic context, it is sometimes difficult to measure the former objectively, but almost impossible to measure the latter.

In prayer, we address God and believe we are heard. However, God might not need to hear our prayers. Nachmanides, Talmudist and mystic of the thirteenth century, emphasized that prayer is not mandated at all by the Old Testament. In the development of religion, prayer replaced sacrifice. Nachmanides considered prayer to be God's gift to us, not our gift to God.[7] The Jewish concept is that very little of prayer is intercessory. Most prayer is meant to enhance our living a moral life and doing good deeds. According to Abraham Joshua Heschel, piety cannot consist in prayer or ritual observances only, but is bound up with all actions.[8]

There are other views from the Jewish tradition. For example, Jerome Gellman interprets the Hebrew word *mit'aveh* (God's desire for prayer) as a "lusting for a thing itself and not as a means to something else. God craves or lusts after petitionary prayers."[9] By a desire to hear our voice, God shows us love, and makes it clear that a personal relationship with us is sought.

Does God respond to individual prayers by acting in the physical world? Polkinghorne divides divine action in the physical world into general providence, special providence, and miracle,[10] and assumes that "petitionary prayer implies belief in a God who acts in the particular as well as in the general."[11] Eleonore Stump clarifies that "answering petitionary prayers does require God's intervention in the world, but divine intervention need not be miraculous."[12]

Many others have strongly rejected this possibility. For example, the Jewish philosopher and physician Maimonides (c.1135-1204 C.E.) wrote in the third of his "Thirteen Principles of the Jewish Faith" that physical concepts do not apply to God. Teilhard de Chardin declares that "if God allows us to suffer, to sin, to doubt, it is because he cannot here and now cure us and show himself to us."[13] In Tillich's view, "the concept of a 'personal God,' interfering with natural events...makes God a natural object beside others...[and results in] the destruction, not only of the physical system, but...of any meaningful idea of God."[14]

What does scripture tell us about the efficacy of petitionary prayer for healing? Isaacs summarizes:

> Abraham prayed for Avimelech (Genesis 20:17), and God healed him. David prayed for the recovery of his son (2 Samuel 12:16), but his son died. Elisha prayed for the recovery of the Shunammite woman's son (2 Kings 4:33), and the boy recovered. King Hezekiah prayed for his own recovery (2 Chronicles 32:24), and God added an additional fifteen years to his life. The shortest prayer on record is the famous prayer uttered by Moses for the recovery of his sister, Miriam, who was afflicted with leprosy. Moses said: *El na refa na la* (O God, heal her, I beseech You), and she recovered (Num 12:13).[15]

While Richard Swinburne observes that there were unanswered prayers both of St. Paul (2 Cor 12:7-9) and of Jesus himself (Mark 14:36),[16] it is written elsewhere that all faithful prayer will be answered:

> And Jesus answered them, "Truly, I tell you, if you have faith and do not doubt, not only will you do what has been done to the fig tree, but even if you say to this mountain, 'Be lifted up and thrown into the sea,' it will be done. Whatever you ask for in prayer with faith, you will receive."
> (Mt 21:21-22)

Also, the book of Sirach, in the Apocrypha, asserts that prayer to God will bring healing:

> Honor physicians for their services,
> for the Lord created them;
> for their gift of healing comes from the Most High,
> and they are rewarded by the king.
> The skill of physicians makes them distinguished,
> and in the presence of the great they are admired.
> The Lord created medicines out of the earth,
> and the sensible will not despise them.
> Was not water made sweet with a tree
> in order that its power might be known?
> And God gave skill to human beings
> that God might be glorified in the Lord's marvelous works.
> By them the physician heals and takes away pain;
> the pharmacist makes a mixture from them..
> God's works will never be finished;
> and from God health spreads over all the earth.
> My child, when you are ill, do not delay,
> but pray to the Lord, and God will heal you.
> (Sir 38:1-9)

Thus, the New Testament writings suggest that God wants to be asked and that an answer can be expected: "Ask, and it will be given you" (Mt 7:7). Maybe this holds true also for petitionary prayers for healing.

One important point to keep in mind, however, is that a distinction should probably be made between prayer for healing and prayer for recovery from sickness (or cure). While the two may overlap to a certain extent, they may be completely independent. While cure is the restoration of bodily or mental health from a disease as defined by current biomedical standards, healing is well defined by Pilch as the restoration of meaning to life.[17] In the epidemiologic context, it is sometimes difficult to measure the former objectively, but almost impossible to measure the latter.

Reflexivity

We sometimes pray for others and sometimes for our own healing and cure. This distinction between reflexive and non-reflexive (intercessory) prayer is of crucial importance for any empirical research into the issue of therapeutic prayer. When praying for ourselves or others, we ask God for a favor. We bring before God our wishes for our own future or for those we pray for. This is what happens, for example, in some liturgical prayers of congregations. If we ask for a specific outcome of a situation, e.g., when praying for the recovery from disease, we ask God a specific favor: to direct the future in a desired direction. Jerome Gellman has offered the following view, in his "impetrative" scenario of petitionary prayer:

> [I]ntercession demands a closeness to God greater than that for prayers for oneself. In intercession, a person asks God to heal another, but asks for that help as a personal favor to her, the person who prays…[which] requires a bit of *chutzpah*.[18]

Evidence

In his editorial comment upon Eisenberg's first report, Edward Campion[19] states that "the reason people go to nonmedical practitioners is simple: they want to feel better." The question remains: Why do they feel better? Campion suggests that "access is easy. Invitations to be healed are everywhere. It's cheaper than seeing a physician." Dissatisfaction with the medical establishment might be another reason to consult non-traditional healers. Yet another is that some "unconventional" healing methods might actually be better than conventional ones. But how can it be ascertained that one therapeutic approach is superior to another? The academic discipline concerned with such issues is the branch of clinical epidemiology called "evidence based medicine."[20] Clinical epidemiologists try to discover whether this therapy works, and if so, whether it works better than the current standard.

Indeed, some recent overviews conclude that there might be an association between frequency of attendance at religious services[21] and prayer[22] and health outcomes. Many of these studies are observational studies, in which groups of individuals are defined by their religiosity and related behaviors, and compared regarding their health status. Such observational studies, however, can only provide indirect support for the hypothesis that faith heals, because in this kind of study one measures associations, not causative influences.

Currently, the best information comes from randomized controlled trials, in which an intervention is applied to only one of two otherwise identical groups of individuals. Since religious beliefs and behaviors cannot be randomized, most of what is available in the literature is from randomized trials of remote intervention, i.e., intercessory prayer and distant healing. Indeed, a small but impressive body of literature suggests that intercessory (distant) prayer improves the chances of recovery from illness.[23] What follows are examples of such interventional studies on prayer efficacy. This section by no means attempts to provide a comprehensive overview of the current literature.[24]

Study examples

In the mid-sixties, Joyce and Welldon[25] published what is now considered the first trial of prayer and health. A group of 38 patients with "psychological or rheumatic disease" from two outpatient clinics in London were matched on age, gender, diagnosis, and "religion" (categorized as being Anglican, Roman Catholic, Jewish, or agnostic). The intervention consisted of intercessory prayer by a designated individual or prayer group that had no physical contact with or knowledge about the patient who was being prayed for. In a sequential analyses, the first six results showed an advantage for those "treated," while five of the next six showed a benefit for the control group. Overall, no significant differences were found between groups with regard to clinical state or attitude scales.

Collipp[26] randomly chose 10 of 18 children with acute leukemia. For each of these 10 children (in New York), one Protestant family (in Washington) prayed daily for fifteen months. Neither the attending physicians, nor the patients, nor the prayer groups were aware that they participated in a study of the efficacy of prayer. After 15 months, only 2 of the 8 control children, but 7 of the 10 children in the intervention group were still alive. Collipp correctly states that several characteristics of his study preclude definite conclusions, but that it "does support the concept that prayers for the sick are efficacious."

In a double blind, randomized clinical trial of intercessory prayer, Byrd[27] studied 393 coronary care unit patients. Intercessors prayed daily outside the hospital for the patients in the intervention group until discharge (N = 192). The main result from this study is that patients in the prayer group (versus controls) were more likely to have a "good" hospital course (85% vs 73%), and (accordingly) less likely to have an "intermediate" (1% vs 5%) or "bad" course (14% vs 22%) ($P < 0.01$).

Forty patients with AIDS (20 prayed-for and 20 controls) participated in a pilot study on distant healing.[28] An elaborate treatment schedule was worked out for distance healers, who were from various backgrounds including Christian, Jewish, Native American, Buddhist, Shaman, and bioenergetic/meditative healing. Healers were instructed to "direct an intention for health and well-being" to the subject, of whom they were given information packets, including photographs, first names, and some medical information. Healers rotated, so that each patient in the treatment group received treatment from different practitioners. Patients in the treatment group experienced significantly fewer and less severe new illnesses, reduced medical utilization, and improved mood.

In a trial of intercessory prayer in coronary care unit patients, Harris et al.[29] randomized 1013 patients to receive prayer (N = 484) or usual care (N = 529). Patients in the treatment group were prayed for individually on a daily basis for 28 days by prayer teams who were asked to pray for "a speedy recovery with no complications." While the mean length of stay both in the coronary care unit and in the hospital did not differ between groups, some improvements were seen with regard to clinical outcome. Harris and colleagues also compared the outcome in both groups using the classifications "good, intermediate, or bad" from the Byrd study (see above). No apparent differences were observed. The two major problems in this study are that the allocation to each group was performed by one person on the basis of the last digit of the patient's medical record number, which cannot be considered random, and that the patients were not asked if they wanted to be included in such a study.[30]

Observational studies can only provide indirect support for the hypothesis that faith heals, because in this kind of study one measures associations, not causative influences.

Future research programs

What follows from the studies reviewed above is that it appears scientifically possible to study the health effects of religiousness and the efficacy of prayer. Future research programs in this field should, at least for the time being, strictly adhere to the current epidemiologic research paradigms. This includes the appreciation of ethical and technical issues, some which are discussed further in the final section of this essay. One example is the ethical implications of blinding study subjects with regard to group assignment. Written informed patient consent is a sine qua non. The technical impossibility of controlling for prayers offered by individuals outside the study, needs to be addressed. Moreover, spiritual concerns (including questions such as, Does prayer need testing?) need consideration.

Indeed, areas of particular interest for future research would be those where the recipients of the prayer would be perfectly blind with regard to whether they "received" prayer or not. In one possible setting one could study the health effects of intercessory prayer for newborns; another would include comatose patients receiving intensive care. In both scenarios, one would need to adjust in multivariable regression models for prayers offered by family, friends, and health care professionals.

Another important area of future research would be the effect on patient outcomes of the spiritual practices (including prayer) of healthcare providers. For example, in a survey of 47 health care professionals in a neonatal intensive care unit, 83% responded positive to the question, "Do you pray for your little patients?" (Elizabeth Catlin, personal communication). The impossibility of blinding and randomization are obvious drawbacks in this scenario. However, it appears to be a crucial area, not so much in the metaphysical sense (for positive results could always be explained "naturally" as internal mind-brain-body effects induced within the healthcare providers, enhancing their delivery of therapies) as in the practical sense of defining an optimal standard of care.[31]

Explanations

The apparent association between prayer and recovery in epidemiologic studies deserves explanation. While the health effects of religious behaviors and self-centered prayer can be explained within the current biomedical framework, it is much more difficult to explain distant cure, the therapeutic efficacy of intercessory prayer.

Religious behavior

The association between frequent religious service attendance and better health can be explained by a beneficial effect of religiousness on life style and health behavior. For example, it is reasonable to assume that religious people are less likely to smoke and more likely to focus on a healthy diet than their less religious peers.[32]

In another line of explanation, some critics have suggested that good health is a prerequisite for frequent service attendance. In other words, they hypothesize that the causal arrow goes from health status to service attendance, not vice versa. However, some data indicate

> (a) that attendance at services is a strong predictor of better functioning, even when intermediate changes in functioning are included, (b) that health practices, social ties, and indicators of well-being reduce, but do not eliminate these effects, and (c) that disability has minimal effects on subsequent attendance.[33]

Insights from psychology, neurology, endocrinology, and immunology open another possible door to the black box of faith and health. This research is called neuroimmunomodulation, psycho-neuro-immunology, or neuroendocrinimmunology.[34] In essence, these terms refer to research into the biological links between psychological factors and their effects on the brain and body, as measured by hormone and immune markers. Since much of this phenomenon probably depends upon feedback mechanisms, it might be called the "Mind-Brain-Body-Loop." Is this part of what Teilhard de Chardin had in mind when he wrote that "the more miracles are studied medically, the more...they will be found to be extensions of biology"?[35] Some of the intriguing connections between the mind, brain, and body can probably be modified and, thus, might offer the opportunity for therapeutic intervention. Bruce Rabin[36] has asked whether "behaviors can be adopted that ameliorate the effects of stress on activating hormonal changes that alter immune changes." It is tempting to view prayer as one potentially stress-buffering behavior.

When we turn to God in prayer, we withdraw our attention from the outside world and enter a state of mind that is quite different from the alertness necessary to safely maneuver through everyday life. How does prayer affect our body? It is quite conceivable that the state of mind we enter in prayer affects our body as do states of mind associated with what has been called transcendental meditation[37] or the relaxation response.[38] Furthermore, it is conceivable that these changes prospectively affect our health. For example, it appears that prayer affects our immune system. The evidence is sparse, but a few studies have shown associations between frequency of religious attendance and prayer, and levels of immune markers such as interleukin-6 and T-helper cells.[39] Obviously, much further research is needed before the inference can be drawn that prayer indeed strengthens the immune system.

To use epidemiologic lingo, the Creator will probably remain the "ultimate residual confounder," the unmeasurable factor related to all antecedents and all outcomes.

Intercessory prayer

While lifestyle, health behavior, and the mind-brain-body-loop might partially explain the observation that religiousness and praying improves one's own health, they cannot explain beneficial effects of intercessory prayer for the recovery of others.[40] The hypothesis that intercessory prayer is effective goes one step beyond (intrapersonal) Cartesian dualism,[41] by holding that the state of mind in one person changes the bodily state of another person. How can one person's mindset affect the body of another individual, even over long distances? In essence, a positive result of a perfectly blinded study[42] of distant prayer for the recovery of another person can probably not be explained by any behavioral mechanism or placebo effect. Here, only chance, remote forces (such as those explaining the moon-tides relationship), natural (i.e., not divinely initiated) superempirical mechanisms that cannot (yet?) be measured, or divine intervention remain as explanatory options.

And yet, any understanding of these issues will probably need to take into account alternative visions of reality. For most of those who are used to looking for hard data in support of a hypothesis within the current biomedical explanatory framework, this is the point of disconnect. In other words, any future inquiry into the issue of how distant healing "works" will need either to incorporate non-traditional aspects, or to modify the traditional medico-scientific thinking so that it opens up to currently unacceptable explanations. One such future framework was recently offered for the spirit-health link by Bruce Epperly, who suggests we look at the future of medicine from a process-relational standpoint, noting that "everything in one's environment makes a difference in health and illness."[43]

Elizabeth Targ attempts to integrate local and distant effects by arguing that distant healing might mainly work as a modifier of "other mechanisms including mind-body effects, patient expectation, and medical intervention."[44] In this scenario, the intercessory prayer alone does not necessarily elicit its own effect, but modulates other effects. In a somewhat simplistic example, the mind-brain-body-loop might have different effects in otherwise comparable individuals if one is being prayed for and the other is not. This is what epidemiologists call effect modification: one factor modifies the effect of a second factor upon a third; a concept of immense value for those who set out to study formally the efficacy of distant healing. However, if such an effect modification were found empirically, it would still be hard to explain, just as the effect itself.

But can it ever be known whether God responds to prayers? Should we even consider *not* asking this question? One answer to this is Teilhard de Chardin's:

> God is knowable by human reason. And yet, the miracle is absolutely necessary, not only because it is needed in apologetics, but also for the joy it brings to our hearts: the heart cannot find complete rest in a God whom it does not feel to be stronger than anything that exists.[45]

Can it, should it be studied?

Much of the current lively debate about these findings deals with the question whether religious variables deserve any attention from medical researchers. To the faithful, this question may seem a little odd, and their immediate response might be, "No, of course not! This would mean to test God!" Bystanding medical bench scientists may raise their eyebrow and grumble, "Mumbo-jumbo."[46] However, some curious contemporaries might say, "Sure, why not? Let's find out about God's ways!"

Indeed, let me offer two somewhat provocative hypotheses as a starting point:

(1) the therapeutic efficacy of prayer can be studied, and

(2) the therapeutic efficacy of prayer should be studied.

The following discussion centers around these propositions.

Can it be studied?

The first hypothesis is that the effects of religiousness on health can be studied. Is this so? My answer is "empirically, yes." Modern observational epidemiology can help us find out about associations, but can hardly prove causation. Interventional studies, if well designed and conducted, can provide evidence that helps to reject the null-hypothesis, which states that prayer does not work. However, divine intervention can never be proven directly in a clinical trial. After all, this is probably not the goal of all the prayer research. Harris and coworkers state the following:

> We cannot know why we obtained the results we did.... [W]e have not proven that God answers prayers or that God even exists. It was intercessory prayer, not the existence of God, that was tested here.[47]

Technically, it makes no difference whether secular or spiritual variables are used in epidemiologic studies, as long as they are operationalized in a reproducible fashion. However, it remains to be shown how scientifically to prove God's action in the world (whether there is such, and whether it is a proper object of science). To use epidemiologic lingo, the Creator will probably remain the "ultimate residual confounder," the unmeasurable factor related to all antecedents and all outcomes.

Scientists would perhaps appreciate a scientific proof that prayer "works," while millions of believers would probably be fully convinced without such proof, relying on their own experience that it does. It is an interesting fact that many physicists, who work to increase our understanding of "how the world works," have sooner or later developed a very close relationship with religion (prominent examples being Albert Einstein, Carl Friedrich von Weizsäcker, and Paul Davies). Some of them have even, as Polkinghorne likes to put it, "turned around their collar." The scientist's view might be that we do not really have the knowledge that prayer heals unless we use current scientific methodology to show that it does, while the faithful might still ask why prayer needs to be tested (see below). Apparently, we need to integrate the scientific and religious concepts of knowledge further, in order to be able to proceed down this avenue.

If God is the Creator and Sustainer of everything, including all facts of science and health, then by definition God's ways are always examined when one studies the efficacy of any intervention in medicine.

One possible flaw of observational studies rarely discussed even in the better methodologic literature is what might be called researcher bias. Might investigators who are believers perform an analytical task differently from non-believers, and are their inferences the same? A possible effect in the opposite direction might occur after a study is completed. Experts who review papers for publication are apparently prejudiced against unconventional forms of therapy. Among experts who were given fabricated research reports for review that differed only by name and nature (conventional vs. unconventional), the reviewers were three times more likely to favor the orthodox therapy.[48]

Should it be studied?

Second, I claimed that the health effects of prayer should be studied. Is this so? My answer is still "yes," despite the fact that an epidemiologic approach needs to put religion and prayer into the rather secular category of health antecedents such as gender, age, and smoking. The question for research ethics remains whether or not formally to investigate prayer just like any other medical intervention. In this context, traditional voices admit:

> If prayer is going to be weighed and measured by scientific standards, it cannot be viewed as special in any way.... There is no reason, so long as the scientific approach is taken, for prayer to be ruled out of bounds.[49]

From a medical standpoint, Rosner asks:

> For what purpose...does the efficacy of prayer have to be scientifically proved? ...Will the majority of mankind change its praying habits on the basis of the results?[50]

Probably not, but would it not be more than enough if these studies continue to make an important contribution by furthering the integration of faith issues into current biomedical research, stimulating thought and conversation?

From a theological perspective, Betsy Perabo suggests that "if religions are to use science as a confirmation of their beliefs, they must be willing to operate on science's own terms." [51] The question remains whether this is what religions want. However, Perabo offers an outline of future research and discusses the possible implications in a rather courageous and refreshing way. She concludes:

> If the effects of prayer are, in fact, real and reliable, they should be tested; and if the tests generate scientifically verifiable results, they should be used as a scientific basis for theological inquiry.[52]

Other critical views come from Steven Goldberg,[53] who sees the formal study of prayer as a threat to its traditional role; and from Sloan et al., who suggest that attempts to introduce religious behaviors as medical treatments trivializes religion. Some have even argued that the scientific study of prayer efficacy comes close to testing God.[54] Others have turned this argument around, saying that reliance upon prayer alone amounts to testing God.[55]

Indeed, should not the attempt be made to find out as much as humanly possible about God's ways of healing and restoring health? If God does not want humankind to find out about creation and causation, why these fires in the bellies of cohorts of researchers who devote their lives to science? Could not science be viewed as God's offer to humankind to utilize all physically available information to understand and use this knowledge to improve the quality of human life? Is there not the obligation to find out, for the benefit of future generations? Finally, is not increase in knowledge inplied in the commandment to "fill the earth and subdue it" (Gen 1:28)?

Or should the words, "Blessed are those who have not seen and yet have come to believe" (John 20:29), be interpreted as a divine veto against the study of therapeutic prayer? I believe not. Instead, I offer the argument that if God is the Creator and Sustainer of everything, including all facts of science and health, then by definition God's ways are always examined when one studies the efficacy of any intervention in medicine. My main conclusion is, therefore, that systematic scientific study of the effects of religious factors on health should proceed, including the therapeutic efficacy of prayer, both intercessory and for oneself. Of course, matters are much too complex to be resolved conclusively within the next few decades. But the technical difficulties should be resolved much more easily than the ethical obstacles introduced by a strong fundamentalist opposition against any scientific inquiry into God's ways. In response to such fundamentalist position, John Hick speaks for me:

> Is it impious to try to understand God's dealings with mankind? Surely, if theology is permissible at all, it would be arbitrary to disallow discussion of the topics that come under the rubric of theodicy: creation, the relation of human suffering to the will of God, sin and the fall of man, redemption, heaven and hell.[56]

As an advocate of process theology, Epperly suggests that:

> In exploring our own creativity and advancing the boundaries of life and death, we are not intruding on God's territory by "playing God." Rather, we are creating a new world of care and compassion in partnership with God. As ultimate member of the partnership, God's aim is toward the most creative solution or discovery.[57]

Obviously, the goal of all efforts in the field of prayer efficacy research is to determine whether prayer should be included in the medical armamentarium. Most recently, the exchange of ideas regarding this question among researchers and clinicians culminated in the publication of an article in the prestigious *New England Journal of Medicine*, entitled "Should physicians prescribe religious activities?"[58] that represents only the tip of the iceberg of an intensifying discourse about the integration of religious aspects into medical care. Naturally, part of this discourse is motivated by turf issues between medical and spiritual caretakers. Nevertheless, another part is motivated by questions asked at the crossroads of religion and current biomedical research paradigms. It is at this intersection where research needs to continue, for the benefit of the health of future generations.

Works cited:

Astin, J. A., E. Harkness, and E. Ernst. "The efficacy of 'distant healing': a systematic review of randomized trials." *Ann Intern Med* 132 (2000): 903-10.

Benson, H., J. F. Beary, and M. P. Carol. "The relaxation response." *Psychiatry* 37 (1974): 37-46.

The Bible. New Revised Standard Version, copyright 1989, Division of Christian Education of the National Council of Churches of Christ in the United States of America.

Byrd, R. C. "Positive therapeutic effects of intercessory prayer in a coronary care unit population." *South Med J* 81 (1988): 826-29.

Campbell, A. Cartesian dualism and the concept of medical placebos. *J Consciousness Studies* 1 (1994): 230-3.

Campion, E. W. "Why unconventional medicine?" *N Engl J Med* 328 (1993): 282-83.

Collipp, P. J. "The efficacy of prayer: a triple blind study." *Medical Times* 97 (1969): 201-04.

Dossey, L. "The return of prayer." *Altern Ther Health Med* 3 (1997): 10-7, 113-20.

Eisenberg, D. M., R. B. Davis, S. L. Ettner, S. Appel, S. Wilkey, M. Van Rompay, and R. C. Kessler. "Trends in alternative medicine use in the United States, 1990-1997: results of a follow-up national survey." *JAMA* 280 (1998): 1569-75.

Eisenberg, D. M., R. C. Kessler, C. Foster, F. E. Norlock, D. R. Calkins, and T. L. Delbanco. "Unconventional medicine in the United States. Prevalence, costs, and patterns of use." *N Engl J Med* 328 (1993): 246-52.

Epperly, B. G. "Prayer, process, and the future of medicine." *J Religion Health.* 39 (2000): 23-37.

Galishoff, M. L. "God, prayer, and coronary care unit outcomes: faith vs works?" *Arch Intern Med* 160 (2000): 1877.

Gellman, J. "Judaic Perspectives on Petitionary Prayer." In *Referring to God—Jewish and Christian Philosophical and Theological Perspectives*, ed. by P. Helm, 129-48. New York: St. Martin's Press, 2000.

Goldberg, S. *Seduced by Science*. New York: New York University Press,1999.

Goldstein, J. "Waiving informed consent for research on spiritual matters?" *Arch Intern Med* 160 (2000): 1870-71.

Hamm, R. M. "No effect of intercessory prayer has been proven." *Arch Intern Med* 160 (2000): 1872-73.

Hammerschmidt, D. E. "Ethical and practical problems in studying prayer." *Arch Intern Med* 160 (2000): 1874.

Harris, W. S., M. Gowda, J. W. Kolb, C. P. Strychacz, J. L. Vacek, P. G. Jones, A. Forker, J. H. O'Keefe, and B. D. McCallister. "A randomized, controlled trial of the effects of remote, intercessory prayer on outcomes in patients admitted to the coronary care unit." *Arch Intern Med* 159 (1999): 2273-78.

Heschel, A. J. *God in Search of Man.* New York: Farrar, Straus and Giroux, 1999.

Hick, J. *Evil and the God of Love.* New York: Harper & Row, 1966.

Hoover, D. R., and J. B. Margolick. "Questions on the design and findings of a randomized, controlled trial of the effects of remote, intercessory prayer on outcomes in patients admitted to the coronary care unit." *Arch Intern Med* 160 (2000):1875-76.

Idler, E. L., and S. V. Kasl. "Religion among disabled and nondisabled persons II: attendance at religious services as a predictor of the course of disability." *J Gerontol B Psychol Sci Soc Sci* 52 (1997): S306-16.

Isaacs, R. H. *Judaism, Medicine, and Healing*. Northvale, N.J.: Jason Aronson, 1998.

Jarvis, G. K., and H. C. Northcott. "Religion and differences in morbidity and mortality." *Soc Sci Med* 25 (1987): 813-24.

Joyce, C. R. B., and R. M. C. Welldon. "The objective efficacy of prayer. A double blind clinical trial." *J Chron Dis* 18 (1965): 367-77.

Karis, R., and D. Karis. "Intercessory prayer." *Arch Intern Med* 160 (2000): 1870.

Koenig, H. G., H. J. Cohen, L. K. George, J. C. Hays, D. B. Larson, and D. G. Blazer.

"Attendance at religious services, interleukin-6, and other biological parameters of immune function in older adults." *Int J Psychiatry Med* 27 (1997): 233-50.

Koenig, H. G., M. McCullough, and D. B. Larson. *Religion and Health: A Century of Research Reviewed.* New York: Oxford University Press, 2000.

Levin, J. S. "How prayer heals: a theoretical model." *Altern Ther Health Med* 2 (1996): 66-73.

Matthews, D. A., M. E. McCullough, D. B. Larson, H. G. Koenig, J. P. Swyers, and M. G. Milano. "Religious commitment and health status: a review of the research and implications for family medicine." *Arch Fam Med* 7 (1998): 118-24.

McCullough, M. E., W. T. Hoyt, D. B. Larson, H. G. Koenig, and C. Thoresen. "Religious involvement and mortality: a meta-analytic review." *Health Psychol* 19 (2000): 211-22.

Meisenhelder, J. B., and E. N. Chandler. "Prayer and health outcomes in church members." *Altern Ther Health Med* 6 (2000): 56-60.

Pande, P. N. "Does prayer need testing?" *Arch Intern Med* 160 (2000): 1873-74.

Perabo, B. "Studying the effects of intercessory prayer on healing: a theological examination." *J Faith Sci Exchange* 1 (1997): 81-86.

Pilch, J. J. *Healing in the New Testament.* Minneapolis: Augsburg Fortress, 1999.

Polkinghorne, J. *Science and Providence.* Boston: Shambhala, 1989.

_____. *Science and Theology.* Minneapolis: Fortress Press, 1998.

Price, J. M. "Does prayer really set one apart?" *Arch Intern Med* 160 (2000), 1873.

Rabin, B. S. *Stress, Immune Function, and Health—the Connection.* New York: Wiley-Liss, 1999.

Reichlin, S. "Neuroendocrine-immune interactions." *New Engl J Med* 329 (1993): 1246-53.

Resch, K. I., E. Ernst, and J. Garrow. "A randomized controlled study of reviewer bias against an unconventional therapy." *J R Soc Med* 93 (2000): 164-67.

Rosner, F. "The efficacy of prayer: scientific vs religious evidence." *J Religion and Health* 14 (1975): 294-98.

_____. "Therapeutic efficacy of prayer." Arch Intern Med 160 (2000): 1875.

Sackett, D. L., S. E. Straus, W. S. Richardson, W. Rosenberg, and R. B. Haynes. *Evidence-based Medicine.* Edinburgh: Churchill Livingstone, 2000.

Sandweiss, D. A. "P value out of control." *Arch Intern Med* 160 (2000): 1872.

Sicher, F., E. Targ, D. Moore, 2nd, and H. S. Smith. "A randomized double-blind study of the effect of distant healing in a population with advanced AIDS. Report of a small scale study." *West J Med* 169 (1998): 356-63.

Sloan, R. P., and E. Bagiella. "Data without a prayer." *Arch Intern Med* 160 (2000), 1870.

Sloan, R. P., E. Bagiella, L. VandeCreek, M. Hover, C. Casalone, T. Jinpu Hirsch, Y. Hasan, R. Kreger, and P. Poulos. "Should physicians prescribe religious activities?" *N Engl J Med* 342 (2000): 1913-16.

Smith, J. G., and R. Fisher. "The effect of remote intercessory prayer on clinical outcomes." *Arch Intern Med* 160 (2000): 1876.

Stump, E. "Petitionary prayer." In *Companion to Philosophy of Religion*, ed. by P. L. Quinn and C. Taliaferro, 577-83, Oxford: Blackwell, 1999.

Swinburne, R. *Providence and the Problem of Evil.* Oxford: Clarendon Press, 1998.

Targ, E. "Evaluating distant healing: a research review." *Altern Ther Health Med* 3 (1997): 74-78.

Teilhard de Chardin, P. *Christianity and Evolution.* Orlando: Harcourt Brace Jovanovich, 1974.

Tillich, P. *Theology of Cu.ture.* New York: Oxford University Press, 1959.

_____. "Das Paradox des Gebets." In *Die neue Wirklichkeit*, by Paul Tillich, 135-38. Muenchen: DTV, 1962.

Tracy, T. F., ed. *The God Who Acts*. University Park, Pa.: Pennsylvania State University Press, 1994.

Van der Does, W. "A randomized, controlled trial of prayer?" *Arch Intern Med* 160 (2000): 1871-72.

Vaux, K. "Religion and health." *Prev Med* 5 (1976): 522-36.

Wallace, R. K. "Physiological effects of transcendental meditation." *Science* 167 (1970): 1751-54.

Waterhouse, W. C. "Is it prayer, or is it parity?" *Arch Intern Med* 160 (2000): 1875.

Woods, T. E., M. H. Antoni, G. H. Ironson, and D. W. Kling. "Religiosity is associated with affective and immune status in symptomatic HIV-infected gay men." *J Psychosom Res* 46 (1999): 165-76.

Zimmerman, S. M. "Prayer can help." *Arch Intern Med* 160 (2000): 1876-77.

Endnotes:

1. Dossey, p 10.

2. Eisenberg et al.

3. Ibid.

4. In this essay the word "recovery" is used as an overarching term for both mental and bodily recovery from sickness or distress. "Healing" is meant to cover mainly spiritual recovery, while recovery of the body and its functions is referred to as "cure." This enables me to look at healing and cure somewhat separately, which may or may not be the case under specific circumstances.

5. Polkinghorne, *Science and Providence*, p. 70.

6. A full discussion of this topic is beyond the scope of this text. An accessible introduction into the related issues in Judaism can be found in Rosner, and Isaacs; an interesting volume from an anthropological Christian perspective is Pilch's book.

7. An interesting Christian perspective in this regard is Tillich's, who wrote, "It is God, who prays through us, when we pray to God." See Tillich, "Das Paradox des Gebets," p. 137.

8. Heschel. I am most grateful to Alan Leviton who pointed these issues out to me.

9. Gellman, p. 134.

10. Polkinghorne, *Science and Theology*, ch. 5.

11. Polkinghorne, *Science and Providence*, p. 69. For an excellent discussion of the question, "Does God act in the physical world," see Tracy.

12. Stump, p. 578.

13. Teilhard de Chardin, p. 132.

14. Tillich, *Theology of Culture*, p. 130.

15. Isaacs, p. 115.

16. Swinburne, p. 115.

17. Pilch, p. 141.

18. Gellman, p. 139.

19. Campion, p. 282.

20. See, for example, Sackett et al.

21. Jarvis and Northcott; Koenig et al.; Matthews et al.; McCullough et al.; Vaux.

22. Meisenhelder and Chandler.

23. Byrd; Collipp; Harris et al.; Joyce and Welldon; Sicher et al.

24. This has been done most recently in several excellent articles (Astin et al.; McCullough et al.) and books (Koenig et al.).

25. Joyce and Welldon.

26. Collipp.

27. Byrd.

28. Sicher et al.

29. Harris et al.

30. The wave of critical responses from the medical community is impressive. See Galishoff, Goldstein, Hamm, Hammerschmidt, Hoover and Margolick, Karis and Karis, Pande, Price, Rosner, Sandweiss, Sloan and Bagiella, Smith and Fisher, Van der Does, Waterhouse, Zimmerman.

31. I am grateful to Mark Heim for most of the points laid out in this paragraph.

32. This leaves the question of why religious people take better care of themselves

than those who are less religious. What comes to mind immediately are religious admonitions to take care of one's health. For examples, Mormons are encouraged to avoid tobacco, alcohol and caffeine. In his introduction to Roberta Leviton's excellent *Jewish Low-Cholesterol Cookbook* (Signet, New York, 1979), Rabbi Meyer Strassfeld quotes Deut 4:15 ("Take care and watch yourselves closely") as Maimonides' justification for taking care of one's body and protecting one's health. I am grateful to Alan Leviton for this point.

33. Idler and Kasl, p.S306.

34. Reichlin.

35. Teilhard de Chardin, p. 29.

36. Rabin, p. 281.

37. Wallace.

38. Benson et al.

39. Koenig et al.; Woods et al.

40. See Levin, for a formal conceptual model of how prayer "works."

41. See Campbell for a brief but illuminating introduction into the "trap of Cartesian dualism" in the context of the placebo effect.

42. In fact, even in a perfectly blinded situation, it will be very difficult to adjust for self-prayer of the study subjects and for intercessory prayer for the study subjects by individuals outside the study setting (family, friends, health care personnel, etc.)

43. Epperly, p. 27.

44. Targ.

45. Teilhard de Chardin, p. 29.

46. I have borrowed this *terminus technicus* from Pilch, 1999, who uses it for what some might call the techniques Jesus used when curing the deaf (Mark 7:31-37). Pilch also notes that this might also be how the precise medical jargon of scientific Western healthcare sounds to the Nepalese.

47. Harris et al., p. 2277.

48. Resch et al.

49. Goldberg, p. 45.

50. Rosner, "The efficacy of prayer," p. 298. See also Rosner, "Therapeutic efficacy of prayer."

51. Perabo, p. 85.

52. Ibid., p. 85.

53. Goldberg.

54. Pande.

55. Perabo.

56. Hick, p. 7.

57. Epperly, p. 34.

58. Sloan et al.

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The use of Human Subjects in Biomedical Research: A Problematic Scientific Past Shapes Present Ethical Challenges

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The ethics of human experimentation is a relatively new phenomenon in medicine. The Nuremberg Code and the Helsinki Declaration focused on informed consent in human experimentation. More recently, ethicists have begun to emphasize that, beyond the need for consent, the "content" of the experiment also needs to be ethical. The method and process of the experiment must be humanizing and affirming of the subject as moral agent. The religious perspective has provided a comprehensive moral foundation, demanding respect for the subjects' moral agency and their right to be treated as equally worthy members of the human community, thus ensuring the integrity of the subject as person.

The moral and medical controversies over the use of human subjects in medical research are a relatively new phenomenon in the long history of medicine. Prior to the advent of World War II, medical research tended to be small-scale and driven primarily by particular therapeutic motives. During this "premodern" period, little attention was given to either research itself or the ethical issues around it. A number of dramatic changes occurred around the time of World War II, which, to a large degree, initiated the modern debate around research in general, and the use of human subjects in particular. During and immediately after the war, medical research became a large-scale, highly organized, and well-funded effort harnessed to military objectives and the national interest. The problems with using human subjects in medical research were spectacularly displayed in the gruesome atrocities perpetrated at the hands of the Nazis and, to a lesser degree, in the early history of human experimentation here in the United States. The ethics of human experimentation has come a long way since the time of these events. Local and national rules have been promulgated and institutional review boards now routinely scrutinize experimental protocols in most hospitals and research centers. Nevertheless, many of the basic issues surrounding human experimentation remain controversial and have thus far evaded definitive resolution. Beyond the universal disapproval of Nazi-style experimentation, there is still a lack of consensus on many aspects of using human subjects in biomedical research. To begin to address the complexity surrounding human experimentation, I shall not only review the history involved, but also the underlying moral norms and principles that are used to justify such actions.

Before looking at any particular historical event, it would be prudent to reflect on the practice of medicine in general. Human experimentation has always been a part of medicine. The practice of medicine, especially in early times, was unpredictable and unreliable. When faced with an ailing patient, physicians chose from among various treatment options, many of which had not been validated or tested by the "scientific method." Rather, treatment represented a good-will attempt to aid the patient in spite of surrounding uncertainty. Notwithstanding immense technological advancements, the inherent ambiguity in therapeutic medicine persists. Both then and now, no two patients are medically identical, and every physician needs to be alert to the possibility that a particular patient could react to treatment in unexpected ways. Faced with this unavoidable uncertainty (and thus the inherent element of "the experimental") in all of medicine, two aspects of the therapeutic relationship make it morally acceptable to proceed with directed treatment plans: the patient has given consent and the "therapeutic experiment" is administered with the explicit aim of securing that particular patient's good. The basis for this therapeutic relationship springs from antiquity and is articulated in the Hippocratic Oath. The Oath, in addition to binding the physician to "do no harm," has also been argued to prohibit an experiment if the foregone conclusion, probability, or *a priori* reason to believe exists that death or disabling injury of the experimental subject will occur. Interpreted in this way, the Hippocratic Oath not only outlines the therapeutic relationship but also the terms and bounds of good research practices. The Oath acknowledges the doubt intrinsic to medicine, but in instructing the physician to "do no harm" and to focus unswervingly on the patient, it provides a moral grounding to guide care. Thus, the Hippocratic Oath itself stands as one of the earlier and more influential documents in the history of human experimentation ethics.

McDermott's utilitarian defense of the prerogatives of research may have represented a broad spectrum of opinion within organized medicine at the time, but a mere five years later, with the shocking revelations of the Tuskegee syphilis experiment, the trust he had called for had been effectively shattered.

Perhaps the single most important contemporary document is the Nuremberg Code.[1] The Code was formulated in 1947 by American Judges sitting in judgment of Nazi physicians accused of conducting murderous and torturous human experiments in the concentration camps. At the Nuremberg trial, the Nazis were accused of using the most vulnerable—institutionalized children, the mentally retarded, and prisoners—in human experimentation without their consent. In their own defense (as posed by Dr. Robert Servatius, a defense attorney at Nuremberg) they offered three cardinal points:

• A state may demand a sacrifice from an individual on behalf of the community; and decisions as to what the interests of the community are, what those interests require, and how great a sacrifice may be demanded are all to be made by the state alone.

• There are no pertinent valid distinctions between conscripting somebody for military service and requiring somebody to submit to medical experimentation.

• In the history of medicine, numerous experiments have been carried out on human beings without their informed consent, and so why should the Nazi physicians be singled out?

The third point is the most easily dismissed. Although it is true that numerous experiments had previously been carried out by physicians on unconsenting human beings (e.g., Walter Reed's yellow fever experiments in Havana, Richard Strong's plague and beriberi experiments in the Philippines, etc.), they still remain the shame of medicine. Citing past moral lapses can hardly be grounds for current legal or ethical leniency. The first two points warrant more thorough philosophical consideration. Both are formulated in terms of the consequentialist or utilitarian theory, according to which what is right is defined to be whatever serves the greatest good of the greatest number. The most familiar articulation of this theory is taken from Bentham and Mill,[2] in which good is identified with happiness. In the utilitarian system of morality, it is morally permissible (even advocated) to sacrifice the rights of an individual if the good of society or "the many" will benefit. By definition, from the point of view of generalized utilitarianism, the only thing that counts in settling any moral question is what would be for the greatest good of the greatest number. Here, society is fully justified to compel unwelcome measures in the name of the social good. In the case of World War II Germany, the defense at Nuremberg argued that the sacrifice of "the few" in medical experimentations would aid the many in advancing the war effort. This conscription of subjects for medical experimentation, it was argued, was no different than the sacrifice being required of drafted men who similarly risked their lives on the front lines. Each party was asked to make sacrifices for the needs of society. In this way, human experimentation without consent was sanctioned and justified.

On October 25, 1946 the indictment of the Nazi doctors was filed. The court, and the world, had rejected the justifications given for the horrifying experimentations performed during the Third Reich. In the wake of the indictment came the Nuremberg Code. This Code continues to define the current ethical discussion around human experimentation. The Code posits research principles deemed necessary for the moral and humane use of human beings in experimental research. The content of the Code can be understood to have two major parts. The first part of the Code concerns itself primarily with a procedural matter—the procurement of voluntary informed consent as an "absolutely essential" condition for using humans in experimentation. A physician should never do anything to a patient or subject that is inherently coercive, and no procedure may be performed without obtaining the patient's full consent. This means that the patient should be

> so situated as to be able to exercise free power of choice...and should have sufficient knowledge and comprehension of the elements of the subject matter involved.[3]

The insistence on informed consent demonstrates the belief that if the process is just, then the substance or content of the experimentation will likewise be morally upright.

The second part of the Code focuses more explicitly on the substance of human experimentation. It defines a set of specific criteria by which the content of the experiment can be judged to be morally justifiable. The second part of the code includes, among others, such criteria as the requirement that the experiment yield fruitful results, not be random in nature, be designed on the basis of animal studies, and be conducted to avoid all unnecessary suffering and injury.[4] This second part of the Code, unlike the first, clearly articulates a proper "content" to be included when constructing human experiments. In a very explicit manner it outlines for the potential researcher a specific standard which must be followed in order to have a morally licit experiment.

The Code has its grounding in a markedly different philosophical tradition from the one used in defense of the doctors at the Nuremberg trials. The Nuremberg Code's emphasis on informed consent, as well as on specific safeguards within the experimental protocol itself, are both designed to protect the patient's or subject's right to the inviolability of person. The moral content of this requirement is perhaps best described by the Kantian principle of treating other persons as ends in themselves and never simply as means to an end they do not share ("the kingdom of ends" argument).[5] The informed consent requirement can be seen as protecting the moral status of persons who also happen to be experimental subjects. In this philosophical scheme, to use a person without consent for an experiment is untenable, regardless of the benefit that society may procure. Each individual person has inherent worth that is inestimable and that cannot be factored into the consequentialist equation. Although society in general may suffer, the preeminent value of each individual cannot be violated. The individual's autonomy demands respect; thus, the decision concerning whether or not to participate in experimentation belongs only to the individual. In this way, the Nuremberg Code insists that medical investigators alone cannot set the rules for the ethical conduct of research. By adopting a human-rights perspective that acknowledges the centrality of the individual worth of each person, the Code forever changed the way human experimentation is viewed.

Following Nuremberg, there were additional attempts at codifying the ethical and moral criteria of human experimentation. The most prominent was the World Medical Association's Declaration of Helsinki in 1964 (subsequently revised in 1975, 1983, 1989, 1996, and 2000).[6] Although the Declaration clearly acknowledges the authority of the Nuremberg Code and grounds itself within it, the Helsinki Declaration attempts to have peer review supplement, and even supplant, informed consent as the central principle. Whereas the Nuremberg Code focused more on the human rights of research subjects, the Declaration of Helsinki centers more on the obligation of physicians/investigators to their research subjects. Despite these differences, the major philosophical principles and norms grounding the declarations are the same. The utilitarian calculus is spurned in favor of a more Kantian deontological perspective. Note the last sentence of the Helsinki Declaration:

> In research on man, the interests of science and society should never take precedence over considerations related to the well-being of the subject.[7]

In each document, persons are given a special moral status that cannot be violated by the researcher or state. Each individual has personal goals, aims, and projects that must be respected. In rigidly codifying the proper relations between physician-researchers and subjects, both the Nuremberg Code and the Helsinki Declaration stress that the good of individual patients must always take precedence over the good of society. Given the basic tension between individual and social rights, not everyone finds solace in these declarations. Some researchers in the 1960s and 1970s rejected the high-sounding declarations and regulations as impractical and impotent for resolving the moral dilemmas around human experimentation.

When challenged by reformers in the late 1960s and early 1970s, many researchers resorted back to utilitarian arguments against increased ethical and legal regulation of biomedical research. A good example of this utilitarian defense can be found in Walsh McDermott's famed 1967 "Opening Comments on the Changing Mores of Biomedical Research."[8] McDermott contended that medical research had bestowed great benefits on society and in so doing had created a kind of societal expectation of—even right to—further research. To satisfy this societal expectation, according to McDermott, there may be times when the good of society must take precedence over the good of the individual. Indeed, not unlike the defense team at Nuremberg, he noted that, outside the sphere of medicine, society often calls for such sacrifices, such as in the military draft. At such times, researchers unfortunately may have to single out certain individuals for participation in research. McDermott, not unlike many of his peers at the time, concluded that society must simply trust the research community to do the right thing, and this community will on occasion need to call for individual sacrifice. McDermott's utilitarian defense of the prerogatives of research may have represented a broad spectrum of opinion within organized medicine at the time, but a mere five years later, with the shocking revelations of the Tuskegee syphilis experiment, the trust he had called for had been effectively shattered.

The history of human experimentation in the United States has had a number of dramatic defining moments. Each in its own way shaped the ethical debate, as well as the policy regulating human experimentation. What can be accomplished here is a brief overview of two controversial studies which significantly impacted the ethical landscape: the Tuskegee syphilis experiment and the Willowbrook School experiments.

In 1932 the U.S. Public Health Service initiated an experiment in Macon County, Alabama, to determine the natural course of untreated, latent syphilis in black males. The researchers recruited syphilitic men by telling the subjects they would be treated for "bad blood." When penicillin became widely available by the early 1950s as the preferred treatment for syphilis, the men did not receive this therapy. Moreover, a federal oversight committee repeatedly decided to continue the study and even on occasion actually sought to prevent treatment. Not until 1972 was the experiment brought to a halt, and in August a "Final Report" was issued that found the study to have been "ethically unjustified."[9] In criticizing the Tuskegee study, the Final Report focused on the issues of penicillin therapy and, more specifically, informed consent. The report makes the distinction between "submitting voluntarily" versus "informed consent." The Report points out that although the participants were "voluntarily" participating with researchers, this in no way signified that informed consent was obtained. Informed consent implies that participation be not only voluntary, but also well informed. The investigation panel held that this criterion of informed consent had not been met, and that the experiment, thus, was both ethically impermissible and against the spirit of the Nuremberg and Helsinki Declarations. The Final Report stated emphatically that

> one fundamental ethical rule is that a person should not be subjected to avoidable risk of death or physical harm unless he freely and intelligently consents.[10]

By focusing on informed consent, the investigatory panel wanted to make it clear that a subject's refusal of treatment must be legally and ethically honored. Personal autonomy over important decisions in one's life, and the right to attempt to realize one's own value-ordering, are so important as to take precedence over the demands of scientific advancement.

The Final Report's almost exclusive focus on informed consent is interesting. Undoubtedly, informed consent is critical to the ethical use of human subjects in biomedical research and experimentation. Informed consent ensures that subjects are treated as moral equals with the experimenters, and as capable of participating in decisions. Despite this importance of informed consent, the ethical scrutiny of human experimentation must not end there. To conclude that a study is ethical, much more than informed consent is required. In a comprehensive ethical analysis, attention must be paid to both the method (i.e., obtaining consent), but also the content (i.e., the type of experiment, the goals of the experiment, who will derive benefit from it, etc.). In its Report, the Tuskegee committee, however, by choosing to focus its ethical condemnation almost exclusively on the lack of consent, rather than on the actual substance of the experiment itself (i.e., the systematic lack of care for the syphilitic men) considers only half the ethical point. It fails to answer the question as to whether there is ever a case when a person can "freely and intelligently consent," but still be the subject of an unethical experiment. In other words, is there any limit to what may be construed as an ethical experiment besides the need for consent? What if the Tuskegee experiment had been exactly the same, except that the men had all given their informed consent. Would it then have been ethical? This question remain insufficiently answered in the Tuskegee Final Report. Although the debate concerning the Tuskegee study moved the issue of human

When the experiment came to public light, the initial discussion centered once again upon informed consent. Although the parents had given consent, there were questions as to whether this had not been subtly coerced, and whether parents ethically could even give such proxy consent for their children.

experimentation forward, there would be other crises that would be needed to refine the discussion further.

The Willowbrook School experiments involved the use of mentally retarded children in hepatitis B vaccine research.[11,12] Upon application to the Willowbrook School, the children's parents were asked permission to enroll their child in the hepatitis study. The study involved purposely infecting the children with hepatitis B in order to test the efficacy of various hepatitis vaccines. This research was carried on for a number of years, until eventually it was exposed in the local and national media. When the experiment came to public light, the initial discussion centered once again upon informed consent. Although the parents had given consent, there were questions as to whether this had not been subtly coerced, and whether parents ethically could even give such proxy consent for their children. Despite this early debate around informed consent, subsequent discussions proceeded to focus more on the actual substance of the experiment. Ethicists began to question whether it was even ethical to use human subjects in these types of experiment, regardless of whether consent had been obtained. David D. Rutstein noted that

> ethical constraints that prohibit certain human experimentation are similar in their effects as are scientific constraints on the design of experiments.[13]

In research on infectious hepatitis, a scientific constraint is applied by the fact that no laboratory animal susceptible to hepatitis has been found in which the large quantities of the virus needed for vaccine manufacture can be grown; and an ethical constraint is the injuction "not...to use human subjects for the growth of a virus for any purpose."[14] Here one can see that unlike in the Tuskegee Final Report, the emphasis is more on the content of the experimental proceedings rather than on merely the obtaining of consent. Rutstein and others want to emphasize that in evaluating the ethics of human experimentation informed consent is necessary, but not sufficient. Although the informed and voluntary participation of the subject is obligatory, informed consent by itself does not make for an ethical experiment. The ethical status of human experimentation also depends on the nature, method, and goals of the ongoing research study.

In light of the lessons learned from history, what moral norms or principles should guide the use of human beings in medical research today? As noted, traditionally, many have appealed to the utilitarian philosophy. Medical research has the ability to generate an almost inexhaustible amount of data to benefit all of humanity. Realizing this, society has come to expect the benefits of this research as an implicit right. If a few individuals should happen to suffer to obtain this progress, it is justifiable because the larger society is overwhelmingly benefited. As McDermott states,

> to ensure the rights of society, an arbitrary judgement must be made against an individual.[15]

In this consequentialist scheme, the rightness or wrongness of any human experimentation is judged by its consequences, or what happens as a result of the experiment. There are several advantages to using utilitarianism to guide human experimentation. It provides researchers with guidelines for deciding what to do: namely, whatever produces, on bal-

In* Evangelium Vitae, *John Paul II acknowledges this notion of life's sanctity, but moves to a much more radical position of the source of life's sacredness. Not only God's external sovereignty over life, but, more fundamentally, the very creation itself of life gives it its sanctity.

ance the greatest good for the greatest number. Moreover, the "greatest good" is allegedly something empirical, something both measurable and comparable. In biomedical research, the "greatest good" can be quantified by measuring lower societal morbidity, mortality, illness rates, etc., regardless of whether a "few" individuals had to suffer in the research process. In principle, therefore, utilitarianism provides definite answers to the question of how we ought to act when considering human experimentation: if the greater good (i.e. society, state, nation) will benefit, it is morally justifiable.

Utilitarianism can be subjected to a number of objections and criticisms. As a guide to human experimentation it ultimately fails, as it undermines the basic integrity of the experimental subject as person. Utilitarianism requires a calculation of the probable consequences of each experiment in order to judge its ethical character. In doing this, the human subject loses full personhood and is transformed into a thing—a unit to be fed into the utilitarian calculus. In Martin Buber's terms, a person moves from being a "thou" to an "it."[15] Here the value of life becomes discontinuous. Life, and its worth, is calculable; it is placed on a sliding scale: if the sacrifice of a single life can benefit others, it can be morally justified. Among other reasons, this aspect of utilitarianism is inadequate as a moral theory, as it conflicts with some of the most basic moral intuitions. Most people would agree that to kill an innocent person to benefit society could hardly be justified. Similarly, most would say that the sacrifice of individual human subjects is not acceptable, even if to benefit society at large. Ultimately, utilitarianism fails because it does not recognize the special and inviolable moral status of each person. As Henry Beecher observes,

> a particularly pernicious myth is the one that depends on the view that any ends justify means. A study is ethical or not at its inception. It does not become ethical merely because it turned up valuable data. Sometimes such a view is rationalized by the investigator as having produced the most good for the most people. That is blatant statism. Whoever gave the investigator the god-like right to choose martyrs?[17]

In contrast to utilitarianism, Kant regarded each person as possessing an inviolable moral status. In this deontological perspective, every person must be treated as an end, and never merely as a means to fulfill the purposes of the few or the many. This Kantian ideal is reflected in the insistence that patients and research subjects must give their informed consent before they can be treated or used in experiments. In this scheme, autonomy and self-determination is emphasized. By respecting each individual subject's autonomy, physicians and researchers continue to value them as self-conscious active moral agents. This Kantian principle should take a preeminent position in guiding human experimentation. It rightfully acknowledges each person as an individual who demands respect. By using the Kantian principle, human subjects can never be used simply as means to an end—regardless of how beneficial that end may be. In the Kantian scheme, each individual comes to be seen not merely as "subject," but also as "person." Unlike an experimental subject, a person requires respect, equality, and just consideration. By using this principle to guide human experimentation the preservation of human dignity is ensured.

Although the Kantian principle provides substantial guidance in human experimentation, it is not sufficient. As Hans Jonas notes, this Kantian principle can be overly simplistic in its evaluation of human experimentation.

> What is wrong with making a person an experimental subject is not so much that we make him thereby a means, as that we make him a thing—a passive thing merely to be acted on, and passive not even for real action, but for token action whose token object he is.[18]

Jonas argues that in social contexts others are constantly used as means to ends. For example, at the grocery store the cashier is used as a means to satisfy the end of obtaining food. Using others as means in this way occurs all the time. Jonas argues that this is not the critical ethical point in human experimentation;

rather, what is of ethical concern is the objectification—the making of the subject into a thing. Undoubtedly the Kantian argument has this somewhat in mind with its well-known maxim of "means" and "ends." Jonas, however, wishes to refine the argument by focusing more explicitly on the process of objectification that can occur with the use of humans in experimentation.

Jonas argues that what makes the use of human subjects in experimentation unethical is the reducing of the person to being a mere token "sample." The components of personhood are denied to the subjects of experimentation when they are acted upon without being engaged as individual moral agents. As in the criticisms of the Tuskegee Final Report, Jonas cautions against using mere consent as a blanket ethical sanction for human experimentation. In addition to ensuring informed consent at the start of the experiment, the investigator has the continued duty of upholding the subject's personal dignity and human worth throughout the whole experimental process.

One place where the inherent value of the human subject has strongly been upheld is in the religious tradition, especially as articulated by the Roman Catholic Church. Religious traditions attempt to articulate a basis for the inviolable character of the human experimental subject. Similar to Kant and certain other philosophers, the Roman Catholic Church demands respect for the human subject as person. The Church, however, goes further by providing a source for the special protected status of the person-subject. The Christian understanding of life, personhood, and their relation to God informs opinions on human experimentation. Human life forms the basis of all goods and is the necessary source and condition of every human activity and of all society. In *Evangelium Vitae*, Pope John Paul II specifically addresses the fundamental issue of the sanctity of life.[19] Prior to his writings, the sanctity of life was articulated in an essentially different manner. Life was sacred because it came from the authority of God and, thus, only God had sovereignty over it. As the author of life, only God had the power to extinguish it. In this understanding, the source of life's sacredness lies without. Life itself is not necessarily sacred or holy, but God's authorship and sovereignty over life sanctifies it. Humankind is to be respected in experimentation not because human life is inherently sacred or worthy, but rather because God is sovereign over human life and no one has the right to use it indiscriminately. In *Evangelium Vitae*, John Paul II acknowledges this notion of life's sanctity, but moves to a much more radical position of the source of life's sacredness. Not only God's external sovereignty over life, but, more fundamentally, the very creation itself of life gives it its sanctity. In creating humankind, God breathes a sanctity into life that cannot be abolished. In shifting the focus from sovereignty to creation, John Paul II relocates the sanctity of life from the external (sovereignty, authorship) to the internal (creation itself). In doing this he re-emphasizes the inviolable nature of life. The sanctity of life is not something external that can be detached from life; rather, it resides in the indivisible creation of it by God. He challenges every physician and biomedical researcher to see the sanctity of life deep within the mystery of life itself. Researchers are called to give witness to life as a mystery not wholly capable of comprehension, measurement or quantification. Jersild et al. write that, given the checkered nature of the history of human experimentation,

> this sense of mystery allied with our sense of the sanctity of life, has been seen by Christians to provide an important bulwark in maintaining humane social order.[20]

Attention to life as mystery can serve to keep biomedical researchers mindful of the sanctity of the subjects of experimentation.

Regarding biomedical research, the Roman Catholic Church also cautions

> [A]n intervention on the human body affects not only the tissues, the organs and their functions, but also involves the person himself on different levels. It involves, therefore, perhaps in an implicit but nonetheless real way, a moral significance and responsibility.[21]

Whereas medicine and science can often be reductionistic, viewing individuals as only biological "organisms" or "subjects," the Roman Catholic Church wants to remind us to see each human person as an integrated whole—spiritual and embodied. The Pope reaffirmed this to the World Medical Association in 1993, when he said:

> Each human person, in his absolutely unique singularity, is constituted not only by his spirit, but by his body as well. Thus, in the body and through the body, one touches the person himself in his concrete reality.[22]

Thus, research must work to integrate the good of human life by materially and physically caring for the subject while respecting his or her dignity. In this way, this religious perspective warns against the dehumanizing potential of medical research, where there is always the danger of not seeing the subjects for who they are, but instead for what the researchers design and intend. No matter how good the end product (i.e., earthshaking research results, or the "saving" cure), the experimental procedure must not have been dehumanizing.

In addition to ensuring informed consent at the start of the experiment, the investigator has the continued duty of upholding the subject's personal dignity and human worth throughout the whole experimental process.

By treating subjects as "means" to an "end" we expropriate God's role. Paul Ramsey strongly warns against this type of usurping of God's dominion in his book, *Fabricated Man*.

> We should not play God before we have learned to be men, and as we learn to be men we will not want to play God.[23]

He further argues that we "play God":

> ...[when we] fail to honor the parameters of human life, when we forget that we are essentially creatures of flesh born of other creatures in the midst of love.[24]

In scientific research, care must be taken not to go beyond the parameters of human life and love, infringing on God's dominion and exclusive power to shape the essential quality of life. Christianity, therefore, reminds researchers to deal with human subjects not just as physical bodies, but also as persons with spiritual and emotional needs—as integrated wholes. In this important way, religion can provide a much-needed counterbalance to the reductionistic tendencies of the scientific method. Informed by a religious perspective, the physician-scientist gains an ethical orientation that serves as a guide for the treatment of the research subject as a person who must be protected from harm, engaged as a moral equal, and assured of both moral and physical integrity. Unlike the Kantian maxim of "means and ends," the religious perspective, with its focus on the sanctity of life, the integrated nature of the human person, and the role of compassion and care, provides a more detailed outline of what justice demands when it comes to the human subject. It takes seriously Jonas' caution not simply to avoid using people as means (as this is not entirely possible in reality), but, more importantly, to eschew objectifying others when they become the subjects of experimentation. A religious perspective necessitates that the researcher always direct his or her actions primarily to the cultivation and protection of the individual subject, and secondarily to the benefit of society.

The ethics of human experimentation is still a developing field within medicine. Intense debate began at the time the Nuremberg trials, where a challenge was leveled at the utilitarian justification for the reprehensible experiments performed by Nazi experimenters. The utilitarian approach disregards the inherent and inestimable worth of each person. The subsequent Nuremberg Code and

Helsinki Declarations represent critical advances in ethical thinking in which the inalienable value of the individual is established as the primary good over against any societal claim to research benefits. This philosophical shift represents an embracing of the Kantian principle of never using persons as means to an end. Despite substantial focus on experimental method, the main impact of these documents is the insistence on obtaining the informed consent of research subjects. In the 1970s, ethicists such as Hans Jonas, as well as those criticizing the Willowbrook experiments, questioned whether informed consent is a sufficient criterion for ethical experimentation. They concluded that it is not, and the beyond the need for consent, the "content" of the experiment also needs to be ethical. The method and process of the experiment must be humanizing and affirming of the subject as moral agent. A religious perspective that emphasizes the sanctity of life can serve to guide the ethical character of experimental "content." Such a religious perspective provides a comprehensive moral foundation, demanding respect for the subject's moral agency and right to be treated as equally worthy members of the human community, thus ensuring the integrity of the subject as person. Ultimately, only by validating the worth of the experimental subject as person, and as moral agent, can just and true progress be achieved through biomedical experimentation.

Works cited:

Beecher, Henry. "Ethics and Clinical Research." *New England Journal of Medicine* 274, no. 24 (1966): 1354-60.

Beller, F. K. "History of the Willowbrook State School." *Med Welt* 24, no. 2 (12 Jan. 1973): 79-80.

Buber, Martin. *I and Thou.* Trans. Ronald Gregor Smith. New York: Scribner, 1958.

Declaration of Helsinki. "Ethical Principles for Medical Research Involving Human Subjects." In *Encyclopedia of Bioethics*, vol. V, ed. by Warren Thomas Reich, 2765-2767. New York: Macmillan, 1995.

Department of Health, Education, and Welfare (United States). *Final Report of the Tuskegee Syphilis Study Ad Hoc Advisory Panel.* Washington, D.C.: GPO, 1973.

Jersild, Paul, Dale Johnson, Patricia Jung, and Shannon Jung. *Moral Issues and Christian Response.* New York: Harcourt Brace College Publishers, 1998.

John Paul II. *Evangelium Vitae.* New York: Pauline Books and Media, 1995.

_____. "Dangers of Genetic Manipulation." Discourse to the members of the 35th General Assembly of the World Medical Association. 29 October 1983. May be found on the internet at <www.ewtn.com/library/PAPALDOC/JP2GENMP.htm>.

Jonas, Hans. "Philosophical Reflections on Experimenting with Human Subjects." *Daedalus* 98, no. 2 (1969): 219-47.

Kant, Immanuel. *Fundamental Principles of the Metaphysics of Morals.* Trans. Thomas Abbott. New York: Macmillian, 1990.

McDermott, Walsh. "Opening Comments on the Changing Mores of Biomedical Research." *Annals of Internal Medicine* 67, no. 7 (1967): 39-42.

Mill, John Stuart. *Utilitarianism.* Ed. George Sher. Indianapolis: Hackett Publishing Co., 1979.

The Nuremberg Code. *Trials of War Criminals before the Nuremberg Military Tribunals under Control Council Law No. 10:*

Nuremberg, October 1946-April 1949. Washington: U.S. Government Printing Office, not dated.

Ramsey, Paul. *Fabricated Man.* New Haven and London: Yale University Press, 1970.

Rothman, David J. "Were Tuskegee and Willowbrook 'studies in nature'?" *Hasting Center Report* 21, no. 2 (1982): 5-7.

Rutstein, David. "The Ethical Design of Human Experiments." In *Experiments with Human Subjects*, ed. by P. A. Freund, 383-402. New York: Braziller Library, 1970.

Endnotes

1. The Nuremberg Code, vol. 2, pp. 181-82.
2. Mill, p. 3.
3. The Nuremberg Code, vol. 2, p. 181.
4. Ibid.
5. Kant.
6. Declaration of Helsinki, pp. 2765-67.
7. Ibid., p. 2767.
8. McDermott, p. 40.
9. Department of Health, Education, and Welfare, p. 10.
10. Ibid., p. 7.
11. Beller, pp. 79-80.
12. Rothman, pp. 5-6.
13. Rutstein, p. 390.
14. Ibid., p. 393.
15. McDermott, pp. 40-41.
16. Buber.
17. Beecher, p. 1358.
18. Jonas, p. 233.
19. John Paul II, *Evangelium Vitae.*
20. Jersild, pp. 411-12.
21. John Paul II, op. cit.
22. John Paul II, "Discourse," p. 3.
23. Ramsey, p. 63.
24. Ibid., p. 95.

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Bioethics of Xenotransplantation: Three Religious Perspectives

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The recent explosion of biotechnology has raised many ethical and religious questions among faith communities. Many of these faith communities are attempting to balance modern technology and historical religion. Using xenotransplantation as a case study, the transplantation of genetically engineered animal organs into human beings, this article follows three major religious traditions through the discernment process of how to deal faithfully with this new technology. In addition, the role of the biotechnology industry and the pressures that researchers face are also explored in the context of investigating how to effectively integrate science and religion into future bioethical discussions.

Different religions, and different denominations within those religions, have different orientations to begin the bioethical discussion of the issues surrounding biotechnology. The starting place could be the scriptures specific to each religion, or it could be pure reason, or philosophical mandates, or a mixture of the three. Rarely, however, does this starting place determine the eventual answer of a religious group to a bioethical question. Groups that have widely varying theologies (or no unifying theology at all) often come to the same conclusion through different paths of logic. Rather than the specific theology determining the final bioethical decision, it stems largely from how a religious group defines life.

In hindsight, this orientation is logical, since most bioethical decisions involve determining moments at the beginning or end of life, and the definition life itself. Many of these decisions also involve identifying the role of human life in relation to other forms of life, nonhuman animals and plants. There is another layer of difficulty in bioethical decisions when the life of one requires the death of another (such as those involved in organ transplantation, or when pregnancy threatens the life of the mother). This is when the definition of life becomes critical. When does life begin? When does it end? How is it defined? How is it valued? Does quality of life matter, or is it simply life itself that is valued? Where does human life fit within the schema of all life? Does life exist after death? Is life special, or only an accidental force of nature?

As part of this exploration, I examined the bioethical decision-making process from a variety of different religious groups on the issue of xenotransplantation. In cases where a religious group had not yet developed an official position, information regarding their position on the beginning and ending of life, genetic engineering, animal rights, and other defining issues was gathered. Xenotransplantation involves the implantation of nonhuman animal organs (usually pig, due to immunological similarities, organ size, rapidity of the growth cycle, and the size of litters) into human beings, when human donor organs are unavailable. The issues surrounding this operation are complex. They range from the immediate situation of performing the surgery itself, to future considerations such as possible transfer of disease from one species to another, and the rights of the donor animals, raised in a sterile environment and genetically engineered to ensure a more successful transplant procedure.[1]

While I could continue at length regarding the specific issues surrounding xenotransplantation, the purpose of this paper is to examine the various pressures on the decision-makers of some major religious groups in the United States that draw them toward a specific bioethical conclusion. Since "transplantation reveals cultural values that we assign to our bodies and challenges assumptions concerning the body and personal identity," the topic of xenotransplantation could have a deep impact in the discussion venues of religious communities that perceive the self as sacred and human beings as separate from other animals.[2]

This preliminary study is limited to those groups that have a large population in the United States and use diverse methodologies for determining the bioethical decisions for their religious communities. Three of these religiously oriented bioethical discussions are summarized below: United Methodist, Conservative Jewish and Sunni Muslim.

In addition, I explore how biotechnology industry groups make bioethical decisions. It is important to understand the thought processes of those in the laboratory situations who create the technologies and procedures that must later be debated.

Sunni Islam

The Islamic tradition has an outstanding history with medicine. From the founding of the first formal medical schools to the great "Prince of Physicians," Avicenna (Abu Ali at-Husain ibn Abdullah ibn Sina) of the Middle Ages, the great Islamic kingdoms of the Middle East maintained the traditions of learning and medical education throughout the time when Europe was plunged into the Dark Ages. While their religious books prevented the Islamic doctors of this era from performing autopsies or examining too closely the naked form of female patients, the Islamic medical tradition took giant leaps in performing some of the first pharmacological and wound care studies.[3]

Modern Islam, like many modern religions, struggles in the tension between contemporary knowledge and ancient teachings. However, when the two come into conflict, usually the ancient teachings are given precedent over the contemporary knowledge. Islamic faith holds that the human being is the perfect creation of Allah.[4] Human beings must be honored as human beings; to do otherwise is to insult God. Humans are set both apart from and above the other animals. Therefore, in reference to the xenotransplantation discussion, to utilize any part of an animal to save a human would decrease the resulting value of that human.[5] Rather than being entirely human as God's inviolate creation, the person would be partly human and partly nonhuman; part higher being and part lower organism. Doctors should allow the individual to die with dignity rather than perform a zenotransplantation that would confer the humiliation of living in some partial-human state. Not only would there be religious repercussions for the patient of a xenotransplantation operation, but any doctor performing that surgery would be destroying God's creation and would be called by God to account for that destruction.

This position statement expands beyond the surgery itself, since prior to implementing this type of surgery, experimentation must be performed. This is forbidden.[6] To violate a human being or human tissue through experimentation in xenotransplantation is prohibited since it would ultimately decrease the value of human life. The possibility of saving lives through xenotransplantation is not the primary consideration, since death comes to everyone as a member of God's creation. Dying allows the individual to return to Allah; it is not a tragedy. Rather, it is a gift from Allah as a reward for a good life.[7] To perform extreme measures that violate the human body, such as xenotransplantation, is to deny Allah's gift and to make a demand for more of this life and a spurning of the next. Death is a part of life. While medical research should enhance the life we are given, it should not run counter to the natural state of life and death.[8]

Conservative Judaism

Judaism has a long history with medicine. The tradition's earliest holy writings include many commandments that logically contributed to health and well-being in an otherwise uncertain time. Ritual hand-washing, rapid disposal of the dead, and sanitation rules all served to decrease the level of illness and disease in early Jewish society compared to other groups of that era.[9] In conjunction with their historical position against mutilation of the dead, many Conservative Jewish families today still choose to circumvent autopsy and embalming the dead. This injunction against autopsy did hinder some aspects of historical Judaic medicine, since there was a resulting lack of understanding regarding the internal organs and systems of the body. However, Jewish medical practices remained far ahead of other cultures in the field of preventive medicine until the discovery of germ theory allowed the Western world to catch up with many of the practices the Jewish community had begun thousands of years earlier.

The topic of xenotransplantation could have a deep impact in the discussion venues of religious communities that perceive the self as sacred and human beings as separate from other animals.

In Judaism, theology is completely intertwined in medicine. Only God is acknowledged as *rofe*, or "healer." While this larger concept may be unfamiliar, many non-Jews may recognize the name of the angel Raphel—*Rofe-El*, or "the healing of God"—as a convenient reference point for this idea. Jewish doctors merely assist in God's healing touch. Only God can create life, and only God has the right to take life away. In context, this means that if God provides the means to save a life, then that life must be saved, regardless of whether it breaks a religious commandment. In Jewish medicine, human life must be preserved at all costs. Therefore, when bioethical decisions must be made that would otherwise jeopardize a specific religious law, the decision is always made in favor of life.[10]

Since the Torah obviously does not have any specific commandments regarding xenotransplantation, religious scholars look instead at stories where religious laws were broken under the greater commandment to preserve life. One such passage is the story of David who broke into a religious site and ate the bread that was reserved solely for the priests. God allowed this action, even though it had been previously forbidden in the religious laws, since the bread kept David and his companions from starving to death. Many Jewish scholars apply that story to the current biotechnology discussions, including that of xenotransplantation. In xenotransplantation, animal organs (usually from a pig) are implanted into a human recipient to save the life of a human being. Though kosher laws would prevent the taking of pig flesh into the body (the injunction against eating pork), these dietary laws would not take a higher precedence than saving a human life.[11]

Since preserving human life takes precedence over all other considerations and supersedes all other religious laws, Jewish medical theology has a perspective different from that of Sunni Islam.[12] Therefore, while there remains a great deal of discussion in the Jewish community surrounding various biotechnological advances, particularly in the areas of interfering with God's creation and the bioethics of performing the research itself, there is also a relatively positive reception in those areas that could lead to saving lives.

United Methodist Church

Historically, Christianity has had a suspicious relationship with science and medicine. Stories of healing by faith can be found in the earliest Christian holy writings. By the

Middle Ages, a popular theology had developed around sickness and health. It was believed that God meted out illness as a form of punishment for sins. Only God should perform healing, though humans could precipitate this healing by making pilgrimages and seeking out holy relics. During the same era that Islam was making great strides in science and medicine, Christian Europe closed in on itself, often torturing or killing those who attempted to integrate new techniques or knowledge into medicine. In fact, during that era the Church threatened excommunication to any Christian that studied at an Islamic medical school. While doctors and surgeons (considered much less prestigious than doctors because they manipulated the body, while doctors dealt solely with pharmaceuticals) did practice during this period, training occurred through apprenticeship, and most of the medicine practiced was ineffective at best, and lethal at worst.

Over time, this attitude has undergone a significant alteration, particularly in the liberal Protestant denominations, such as the United Methodist Church (UMC). While remnants of religious suspicion of science can still be found among some Christian groups, many denominations are embracing, or at least considering, most modern medical techniques. Medical study is supported; autopsy, surgery, and medical treatment are no longer discouraged. However, with modern advances that could result in an alteration of the genome and with some forms of medical research, new caution has been raised as to the bioethics surrounding some of these medical procedures.

Since preserving human life takes precedence over all other considerations and supersedes all other religious laws, Jewish medical theology has a perspective different from that of Sunni Islam.

In order to identify and address these biotechnical issues that may have important ethical considerations, the United Methodist Church created The Genetic Science Task Force within the larger committee, Ministry of God's Creation. The larger committee is designed to deal with general biological issues such as ecological stewardship. The Genetic Science Task Force's original role within that group was to specifically discuss medical techniques dealing with genetic engineering, and research in those areas. Over time the role of the Task Force has expanded to include other areas of medical bioethics as well and committee members now include research biologists, medical doctors, and laboratory specialists in addition to theologians. This organization presents its research, deliberations, and conclusions to the larger church body. However since the United Methodist Church has a centralized structure, no sub-body of the church has the ability to speak for the church as a whole. Consequently, the Task Force is quick to point out that they do not speak for the United Methodist Church and their findings do not become church policy unless ratified by the Quadrennial All-Church Conference.[13]

The Task Force has not explored the specific area of xenotransplantation yet. However, their previous deliberations that have been ratified by the entire United Methodist Church include position statements on the topics of cloning and genetic engineering, which can be found in the Book of Discipline of the United Methodist Church in the section entitled "Social Principles: The social community: Genetic technology." The Task Force has created resolutions against the patenting of life in any form. Therefore, claiming that specific plants, animals, bacteria, or even genetic sequences "belong" to any person or company is contrary both to the purpose of good science and to proper stewardship of God's creation.[14] The UMC has also released statements that, while they fully support the use of genetic engineering to eradicate genetic disease or disability, still decry the use of genetic engineering for cosmetic, or socio-economic purposes. Expanding on their genetic engineering position, they state that while they approve somatic genetic alterations (those that affect only the individuals who receive the treatment), they stand firmly against genetic alterations to the germ line (resulting in changes to the sperm or egg cells that could be passed down to the next generation). The United Methodist Church also spoke out against research into any therapies, such as those working with early stage genetic alterations, that knowingly waste human embryos.[15] Interestingly, there is currently no language in their policies regarding the use of fetal tissue, since no agreement has yet been reached on the issue.[16]

As one of the largest organized Protestant denominations in the United States, the UMC is often placed between some members' desire unabashedly to encourage modern technology and its development and the more conservative counterparts that strongly advise caution surrounding the bioethical issues involved in these new technologies. In an attempt to ensure that all the voices be respectfully heard, the UMC does not speak on areas where consensus has not been reached. The Task Force acts only on full consensus. On those topics where consensus cannot be reached, the Task Force, and consequently the United Methodist Church, is intentionally silent.[17] Therefore, since they have not yet explored the topic, the UMC maintains no official position, theologically or ethically on xenotransplantation or on any of the surrounding issues involved, though the church's position on genetic engineering may provide preliminary insight into the Task Force's bioethical deliberations. After the Quadrennial All-Church Conference in 2000, the Task Force renewed discussion on contemporary bioethical issues.

Biotechnology laboratories

For the scientists at the leading edge of this field and in the laboratories, there are multiple concerns, very few of them of a bioethical nature. There are strong economic pressures at work among small biotechnology companies.[18] The companies require expensive equipment and materials that usually are financed by investors (either private or on the public stock markets). Start-up costs alone can easily reach the multi-millions of dollars. These investors expect a return for their financial input relatively quickly. Consequently, these companies feel the pressure to produce and patent their products as soon as possible, so that they can be placed on the market and the investors can begin to reap the benefits from acquiring a piece of the company. Biotechnology companies rise and fall almost on a daily basis; it is a difficult fight just to stay alive in a brutal market. Therefore, it is usually economic pressures, not bioethical ones, which determine the research agenda for a company.[19]

Even if economic pressures are not severe, bioethical issues still do not take the top priority in industrial biotechnology. After economics pressures are eased, the thrill of pure research is the next enticement to take effect. Interviews with a variety of biotechnology scientists suggest that it is the love of exploration that initially drew them into the field.[20,21,22,23] In fact, many of the younger scientists lament upward career movement that usually means less time in the lab and increased time with paper and administrative work. As one young woman mentioned, "If I do a good job doing what I love in the lab, they take me out of the lab and make me do work I hate. What incentive!"[24]

In most cases the biotechnicians are the best equipped both to understand the sciences involved, as well as to speculate on potential harmful outcomes. Yet, due to their formal scientific training requirements, the researchers are possibly the most poorly equipped to understand or predict the bioethical issues surrounding those outcomes. In general, scientific researchers do not have an educational background in ethics needed to formulate these issues for discussion, and they often consider instigating the discussions as one more form of administrative work that would pull them away from their labs.[25] Therefore the discussions, when they occur, will occur less often with the young scientists, who are actually in the laboratories performing the work, and more often with the upper level administration, some of whom have not spent any serious laboratory "bench time" in over ten years.

In general, scientific researchers do not have the educational background in ethics needed to formulate these issues for discussion, and they often consider instigating the discussions as one more form of administrative work that would pull them away from their labs.

The field, however, is beginning to understand the financial value of assessing the bioethical issues prior to moving toward a goal.[26] The industry pays particular attention when the bioethical issues begin to impact their national or international economic interests.[27] Consider the recent example of the need for biotechnology companies to research the bioethical issues before beginning a multi-million-dollar process of developing a new product line: the upheaval in the Monsanto Company when public backlash forced them to remove their new second-generation termination seed from the market. The Monsanto Company created seed that does not have a second-generation germination cycle; that is, seed gathered from the original crop is sterile. Thus, the farmer is forced to buy new seed every year from the company.[28] Bioethicists consequently attacked Monsanto on two points. The first was Monsanto's proposed "humanitarian effort"/tax write-off, the donation of tons of this type of seed to farmers in developing nations. Since small family farms depend on seeds held back from the previous year's crop to replant the following year, this type of seed would lead to a famine after a single growing season. The second point of attack stemmed from biologists concerned about cross-pollination altering the genome of regular crops, making them sterile for the next planting season. Outrages over these possibilities forced Monsanto to back-step and remove their termination seed from the market.[29] Monsanto lost billions of dollars in research and development, as well as a number of their customers, over the issue. However, it forced the biotechnology industry to take an interest in the bioethics of their research. In addition, it provided evidence that grass-roots bioethical movements can make a significant impact and alter the position of major international companies.

Science and religion working together

As evidenced by the three religious perspectives and contrasted with the values of the biotechnology industry, it is obvious that the area of religious bioethics is complex, and many questions need to be answered prior to proceeding with the use of xenotransplantation. Each of the religious groups has carefully considered its position on bioethical issues, and each has a history and tradition to support its current position. Yet, these positions are certainly very different. On the issue of xenotransplantation alone these three groups state positions of "absolutely yes," "maybe," and "absolutely no." How can all of the voices in this country be heard and integrated into policy decisions, particularly when they are so disparate? And when decisions are made, what are the rights of the minority in that decision-making process? While medical capabilities continue to race ahead, there are still issues to be solved prior to their implementation.

There is one major question that ethicists and theologians must be able to answer to ensure a future for ethically considerate scientists. How can ethics be integrated into a standard scientific course of study? And further, how can science literacy be integrated into theological and ethical courses of study? As one of the individuals who straddle these two worlds, I can certainly see the value in creating the "renaissance researcher," an individual who understands both what he or she is creating and the implications of creating it. Humankind has long ago left the "age of innocence," where they can idyllically believe that science and scientists are "pure," and that only those who implement the science must worry about messy bioethical issues. The creators, too, need to understand the implications of what they are creating. However, as the situation currently stands, my undergraduate science degree makes me rather unusual in theological discussions, and my theological training makes me very unique in most scientific settings. Further, my scientist friends look at me askance when I begin discussing the ethical issues surrounding the science involved in a project, and my theology friends are equally discomforted when I begin to talk about the realm of science.

It may be that neither field equips its students to function in the world of the other. Each person has specific aptitudes and interests. It is rather uncommon to find an individual that has both the time and inclination to become fluent in both the realms of science and ethics/theology/philosophy. Further, the professors from those fields would purport that there is not even sufficient time in the current degree programs to get through the necessary preparatory curriculum, much less attempting to add a class outside of the field into an already full schedule.[30] Until curriculum committees of these departments are convinced of the value of cross-educating their students, it will remain a difficult fight to have these classes included in the curriculum.

This is not to say that all hope is lost, however, in attempting to create areas of communication between the two fields. A renewed (or completely new, in many instances) interest in bioethics caused the recent biotechnology conference, hosted by Biotechnology Industry Organization (BIO) in Boston, to draft a set of bioethical principles by which to direct the future of their research.[31] Within the preamble to these principles, one can sense a major change in the attitude the biotechnology industry toward bioethics.

> While biotechnology can greatly improve the quality of life, we recognize that this new technology should be approached with an appropriate mixture of enthusiasm, caution and humility. Biotechnology can provide useful tools for combating disease, hunger and environmental contamination, but it should not be viewed as a panacea or as miraculous. For example, life-saving medicines may have serious side effects, and, while our expanding knowledge of genetics can help create the next generation of medicines, it can also raise important ethical issues.[31]

While this statement may be taken with at least a partial sense of irony, since a representative of the protesters outside the Biotechnology Conference was not allowed to speak inside the meeting hall, the statement at least represents a beginning to opening the discussion with ethicists, theologians and government officials. Additionally, the newly developed biotechnologies with worldwide implications have peaked theology's interest in science as well.

In addition to biotechnology beginning to open its doors, theologians are beginning to recognize the role that they must play in these decisions as well, and that this role must be a central one on the world stage, rather than simply commentary from the behind the curtains. The creation of programs such as the Science and Religion Certificate at the Boston Theological Institute and the doctoral program in Philosophy, Science, and Religion at Boston University shows that there is a movement afoot to train theologians and scientists to range widely across both fields and to be able to influence developments in both. While this, of course, is not the final solution, it certainly is a strong beginning. By increasing theologians' scientific literacy, there will be more opportunities for those theologians to take a meaningful role in future bioethical decisions made at the political, economic, and religious levels

While the door may now be opened, ethicists should not forget the economic pressures that initially opened the discussions.[32] Unfortunately, industry in a capitalist society can be fickle. Should the bioethical discussion ever become sufficiently costly in the industry's cost-benefit analysis, the talks will probably close again. That places the bioethicists in a position of needing to continue the economic pressure on the biotechnology companies. The discussion is beginning, but a vision of what biotechnology can accomplish has only been glimpsed. It is imperative that those who live "dual lives" in the worlds of science and religion continue the discussions.

Concerned ethicists and scientists need to continue the pressure on biotechnology companies, but it cannot stop there. Opening and maintaining the discussion will require a co-operative effort across multiple areas of science and religion. However, in order for the fields to make headway in fruitful discussion, there will be a need for individuals who are fluent in the languages of both areas to act as mediators among the different groups at the table. The first step in creating those mediators begins with educating young scientists in the ethics of their field, and integrating science into a theological curriculum. Only then can discussions continue on equal footing with all parties coming to the table with the bioethical interests of the global community in mind.

Works cited:

Antes, Peter. "Medicine and the living tradition of Islam." In *Healing and Restoring: Health and Medicine in the World's Religious Traditions*, ed. L. E. Sullivan, 173-202. New York: MacMillian, 1989.

Artaz-Regan, Paz. Unpublished telephone interview conducted by Amy Wachholtz, 27 March 2000.

Bach, Fritz. Unpublished interview, conducted at Harvard Medical School, Boston, Mass, by Amy Wachholtz, 10 January 2000.

Eid, Talal. Unpublished telephone interview, conducted by Amy Wachholtz, 27 March 27 2000.

Feder, B. J. "Plant sterility research inflames debate on biotechnology's role in farming." *New York Times*, 19 April 1999, A18-19.

Feldman, David. *Health and Medicine in Jewish Tradition*. New York: Crossroad, 1986.

Meslin, Eric. Unpublished telephone interview conducted by Amy Wachholtz, 11 January 2000.

Muntner, S. "Medicine in ancient Israel." In *Medicine in the Bible and the Talmud*, ed. by F. Rosner, 3-20. Hoboken, NJ: KTAV Publishing, 1994.

Oldman, Beth. Unpublished interview conducted at Bio-Transplant Incorporated, Boston, Mass., by Amy Wachholtz, 9 February 2000.

Patience, Clive. Unpublished interview conducted at Bio-Transplant Incorporated, Boston, Mass., by Amy Wachholtz, 31 January 31 2000.

Rahman, Fazlur. "Islam and Health/Medicine: A Historical Perspective." In *Healing and Restoring: Health and Medicine in the World's Religious Traditions*, ed. by L. E. Sullivan, 149-72. New York: MacMillan, 1989.

Smith, Mary. "Facing death: donor and recipient responses to the gift of life." *Holistic Nursing Practices* 13, no. 1 (1998): 32-40.

Teitel, M. "Monsanto Watch: Food, Health, Hope." *Gene Watch*, 12, no. 11 (1999): 4-6.

Telushkin, Joseph. "Whoever saves a single life it is as if he saved an entire world." In *Jewish Literacy*, ed. by Joseph Telushkin, 529-30. New York: William Morrow, 1991.

The United Methodist Church. *The Book of Discipline*. Nashville, Tenn.: United Methodist Publishing, 1996.

White-Scharf, Mary. Unpublished interview conducted at Bio-Transplant Incorporated, Boston, Mass., by Amy Wachholtz, 9 February 2000.

Wood, James. Unpublished interview conducted at Bio-Transplant Incorporated, Boston, Mass., by Amy Wachholtz, 9 February 2000.

Endnotes:

1. Fritz Bach is Senior Research Professor, Harvard Medical School, Boston, Mass.

2. Smith, p. 33.

3. Rahman, p. 150.

4. Talal Eid is Head Imam of the Islamic Council of New England.

5. Eid.

6. Eid.

7. Antes, p. 186.

8. Eid.

9. Muntner, p. 7.

10. Feldman, p. 24.

11. Ibid.

12. Telushkin, p. 530.

13. Paz Artaz-Regan is Executive Director, Ministry of God's Creation, United Methodist Church.

14. The United Methodist Church, Social Principles: The Social Community: Genetic Technology.

15. Ibid.

16. Artaz-Regan.

17. Ibid.

18. Mary White-Scharf is Vice-President of Research, Bio-Transplant Incorporated, Boston, Mass.

19. Clive Patience is a Principle Scientist, Bio-Transplant Incorporated, Boston, Mass.

20. Bach.

21. Beth Oldman is a Research Associate, Bio-Transplant Incorporated, Boston, Mass.

22. Patience.

23. James Wood is a Research Associate, Bio-Transplant Incorporated, Boston, Mass.

24. Oldman.

25. White-Scharf.

26. Ibid.

27. Teitel, p. 5.

28. Feder, p. 18.

29. Ibid.

30. Eric Meslin is Executive Director, National Bioethics Committee.

31. "Proposed biotechnology ethical principles." Internet document from the Biotechnology Conference website, www.bio.org/bioethics/principles.html, posted 9/24/99.

32. Meslin.

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Toward a Fluid Dance in Seamless Dress: The Field of Pre- and Perinatal Development Challenges Researchers to Integrate Scientific and Spiritual Orientations

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The response of humankind to mystery is explored here, relative to the historically sharp distinction between scientific and spiritual ways of knowing. The evolving image of a dancer in a half-male/half-female costume serves as a metaphor for the rapport between these two basic research orientations, and for how they might be reconciled—in the interest of both research and the researcher. Findings from the highly interdisciplinary field of pre- and perinatal development illustrate the need for an integrated approach to understanding "reality."

> With the eclipse of God by the advent and ascension of reason and science, there is no seeming tolerance for the unexplained, which in earlier centuries would have been relegated to "the work of God." Religion is the answer given in various cultures to those vulnerable areas of life that are not understood, the so-called Divine Mysteries.
> —"Inside The Actor's Studio" [1999], by Sir Ian McKellan

> In mystery our soul abides.
> —*Morality* [1852], by Matthew Arnold

There is a tango-dancer costume I have seen in which the wearer bears all evidence of being a man when seen from one perspective (sporting a dashing tux) and all evidence of being a woman when regarded from the opposite side (in her exotic red dress and stockings.) I find this costume, and the dance made inside of it, a good working image for my understandings of the rapport between scientific and spiritual conceptual frameworks. Like a working title, a working image is a decent place to start, but it will likely need some added nuance, some tweaking, down the line.

The response of humankind to mystery, it seems to me, lies at the heart of this age-old dance. How comfortable are people as individuals, and as a society, existing without "bottom line" explanations for who they are, how they are, why they are? Historically, the comforting notion of "God's doing" once explained the deeper mysteries of life, those gaps of phenomena left unexplained by science (hence the term, "God of the gaps" [1]). However, as humankind progressed in its technology, education and sophistication, the large swaths of life unexplicated by medieval science became increasingly more difficult to discern; the "God-gap" narrowed with each growth-spurt of the upstart disciplines of empirical fact-finding and reality-defining, i.e, *modern* science. Whitehead's "God-shaped hole" [2] was getting backfilled by men and women in labcoats.

What was happening to the experience of mystery in human life? Over the centuries since science sprouted the buds that have become muscled, expert limbs—which have, in turn, nudged God further and further out of the Theory-of-Everything business—human beings have been ever more deeply challenged either to embrace or else to split off its uneasy rapport with some primary and profound mysteries about themselves, their world, and their place in that world.

"In mystery," said Matthew Arnold, "our soul abides."[3] Arnold is a fitting man to quote, as he was writing at the very time that Darwin was writing *On the Origin of Species*, which of course became not only his own landmark work but, with *The Descent of Man*, a primary foundation of the modern scientific understanding of the human animal, and a key pole of a century and a half of science/religion polarity. Sadly, Darwin's evident internalization of that polar split, through which he felt he had to choose between a spiritual life and a scientific life, led him to write, twenty-five years later, that he had lost his enjoyment of the natural scenery, poetry, literature, and the music he once had loved:

> [M]y soul is too dried up to appreciate it as in old days.... I am a withered leaf for every subject except Science.[4]

Darwin felt he had become "a kind of machine for grinding general laws out of a large collection of facts."[6]

Darwin conjures for me the image of a man whose theory developed a potent and powerful life of its own, with which Darwin felt incapable of reconciling, throughout his later years, his growing ambivalence surrounding the subject of chance, God, and "this immense and wonderful universe."[7] It is poignant to consider the limitations of thought from which Darwin—in all his brilliance and thought-*fullness*—seemingly suffered, in light of how some later theologians and scientists, via a process view of theology,[8] would come to regard evolution as inherently and deeply imbued with the Divine. Paleontologist and Jesuit priest Pierre Teilhard de Chardin, who some say predicted the "technological evolution" of the internet decades prior to its emergence, believed that all things, living or not, contain the seeds of life and consciousness; that matter in all forms is imbued with a divine force; and that evolution is both a scientific and a holy process, steeped in what he called "orthogenesis," the divine, evolutionary drive of all things, living and not, toward increased complexity and consciousness.[9] By contrast, in her explication of the relationship between and within the world of spirit and the world of matter—particularly technological creations—and a spiritualized idea of evolution, Jennifer Cobb suggests:

> Darwin was so wedded to the idea of a wholly deterministic God that he was blinded to the glimmers of theological purpose in his own discoveries. The idea that there could be a divine force that necessarily coexisted with random chance simply escaped him.[9]

Science (the masculine half of the tango costume, concerned with objective facts, quantitative measurement, and products) traditionally does not truck with mystery. It is theology, literature, poetry, art—disciplines that deal in the realm of the soul and spirit (the feminine half of the costume, concerned with subjective experience, qualitative inquiry, and process)—whose core is woven through with the glistening threads of life's mysteries. I see Darwin as hollowed out by his discipline, trapped in an all-masculine tango suit, suffering the effects of soulless science. Had he fallen prey to what Ian Barbour so lyrically terms "the liberal myth of progress through science"?[10] As Cobb points out,

> [S]cience without soul cannot lead to deep connection. As we pursue the material and the quantifiable, we become externally identified and, by extension, greatly reduce our ability to join center to center with others. We can see this approach in abundance in

In the past generation, science has even offered up, in the form of memes, a socio-biological explanation for the kinds of uplifting ideas, behaviors, and human creations that might have once have been attributed to expressions of culture, or even (how quaint!) divine inspiration.

> the world around us. In our struggle to find meaning in one of the most powerful consumer cultures ever to erupt on the planet, we fill our lives with things, and our isolation and loneliness only grow.[11]

(It is ironic, but not surprising, that the observations that led Darwin to his landmark theory were carried out largely in environs whose indigenous human inhabitants, given their more "primitive," concrete conceptualizations of reality, which included the imaginative as well as the logical, likely did not experience the hobbling psyche/soma split that evolution doctrine helped carve into Western consciousness.)

Today's techno-researchers in the tradition of Darwin may be seen cruising on browsers instead of *The Beagle*, at risk of losing their own deep connection to that mysterious source that animates a full and quenching life. Cobb quotes philosopher Walker Percy:

> Every advance in our objective understanding of the Cosmos and its technological control further distances the self from the Cosmos precisely in the degree of the advance—so that in the end the self becomes a spacebound ghost which roams the very Cosmos it understands perfectly.[12]

If, indeed, it is in mystery that our soul abides, then our soul is gasping for air in its cramped quarters.

Related to this "disappearing mystery" problem with science and, more insidiously, with the more overarching "scientific-revolution mentality" that permeates more disciplines than the physical sciences—indeed, right into the lay mainstream—is what I call the "disappearing miracle" problem. Cobb raises this as an issue in the field of artificial intelligence (AI) and computational emergence:

> We have a tendency to explain away computational novelty because we can look back at the digital record and see how it happened. We tell ourselves that no matter how complex the resulting computation, it is still a string of code. There is no inherent mystery there, no element that makes the whole greater than the sum of its parts. No mystery, no emergence, no novelty.[13]

It seems to me that this principle has been hard at work in the establishment of the "brainism" so rampant today. In place of God, in the eyes of many scientists—and laypeople as well—the Almighty Brain has been exalted: neuroscience as the new religion of the fashionably informed. An almost palpable group sigh of relief has uttered forth from the science-drunk masses with each of the relatively recent, sizable advances in neuroscience, such as the discovery of key neurotransmitters, the dissection of personality, the wholesale dismantling of melancholic experience by SSRIs. As Tom Wolfe puts it in the title of an essay about neuroscience as science's strategic high ground, "Sorry, But Your Soul Just Died."[14] By all outward accounts in the current, media-driven, Western perception of humankind, sociobiologist Edward O. Wilson was correct in his chilling assertion that "the mind will be precisely explained as an epiphenomenon of the neural machinery of the brain."[15] Nothing more, nothing less?

It seems that at the turn of the millennium, a person can browse the local bookstore for any number of expert explanations for how human beings are products of their genes. Don't worry about free will, though—"it's alive and well, and probably genetic," according to geneticist Dean Hamer.[16] In the past generation, science has even offered up, in the form of memes, a sociobiological explanation for the kinds of uplifting ideas, behaviors, and human creations that might have once have been attributed to expressions of culture, or even (how quaint!) divine inspiration. Wolfe points out Wilson's assertion that all branches of intellectual knowledge will eventually come together under the umbrella of biology, no doubt ushering in a hormones-and-tissue-based Theory of Everything. Muses Wolfe:

> If Wilson is right, what interests me is not so much what happens when all knowledge flows together as what people will do with it once every nanometer and every action and reaction of the human brain has been calibrated and made manifest in predictable human formulas.[17]

I wish to be clear that I do not doubt that virtually every emotion can be mapped on the brain, that tweaking the vigor of my endorphin receptors will put a more enduring smile on my face, that genes can explain why a given pair of twins separated at birth entered different seminaries in the same year after having both married women named Doris, prefer cuffless pants, and share the same nervous habit of tugging on their prematurely gray sideburns.[18] What rankles me is the effect that such scientific advances have on the general perception of how human beings tick (more like a Swiss watch than a Swiss watchmaker), as well as unequivocal announcements of these newly discovered phenomena as being *the* defining factors at work in human beings, absent any hint of anything left unquantifiable. The prevailing mechanistic, reductionist portrait of the human being makes miracles vanish in broad, sweeping headlines. Let me also say that I am casting into bold relief a line in the sand that may not in actuality be as definite as I characterize it: not all neurologists, I am sure, believe that the density, sensitivity, and plasticity of neurotransmitters are the sole definers of human psychic lives. What trickles down to the popular media, however, via announcements of Scientific Breakthrough Discoveries is that this is very close to the case. Understanding more acutely some workings of the human mystery does not necessarily reduce its majesty—but in the binary, black-and-white collective consciousness, that is exactly what tends to happen to the *perception* of the mystery.

I should define my terms, for the sake of clarity. By "mystery," or "miracle," or that "thing left unquantifiable," what do I mean? I mean that swell of heart-squeezing *something* that overtakes a parent who hears his or her baby's heartbeat for the first time; that *something* that presses itself into the awareness of a listener when notes on a page are sung by a vocalist of particular luminance; that *something* that rises from somewhere deep inside to form goosebumps on the skin and moistness in the eyes when one gazes at a pink/orange fireball of sun disappearing behind a cloud-meringue horizon and is filled with an inexplicable gratefulness for the truth-telling courage of Copernicus. The direct experience of a whole being greater than the sum of its component parts, of emergent novelty working its evolutionary magic. My guess is that the *something* is a glimmer of our connection with that process of divinely imbued unfolding, of our connection with everything that has gone before us—including invaluable scientific discoveries—and everything that is to come. It is a flickering, peripheral glimpse of our sacred place in the unbroken web of creation articulated by process theology; not a static gap of yet-to-be-discovered knowledge, related to God simply by virtue of that "information gap," but a dynamic reality synapse, divine in its own right.

Life's beginnings: formulaic or miraculous?

Turning to my own disciplinary field, I see the "vanishing miracle" on display in the oxymoronic phrase used daily by obstetricians, "an uneventful pregnancy." My conscientious obstetrician colleagues might roll their eyes, pleading the need for an expedient shorthand, but I find the term telling. That anyone could ever describe the breathtaking series of miraculous processes that is fetal development as "uneventful" belies, in my view, a particular deficit of perspective: the feminine half of the tango costume, left at home in the corner of the downstairs closet, under the box of "Xmas" decorations.

My field, Pre- and Perinatal Development, studies the stuff of which one of the primary science/religion debates is made: How does life begin? By what forces is the very genesis of self governed? This highly interdisciplinary field is itself an excellent example of the need to bridge scientific and spiritual ways of inquiring, as it encompasses such topics as the bio-behavioral aspects of embryonic and fetal development, including unfolding neurological function and the expanding boundaries of memory; the first stirrings of consciousness (and thus psychic life) in the fetus; the effects of maternal emotions, mental states, and behavior on fetal development and birth outcomes; and the effects of cultural attitudes, norms, and mythology on the experiences of pregnancy and birth.

The foundational questions for me are these: Can those early shaping forces be captured in theories, measured and replicated? or are more unfathomable, intangible, ineffable influences at work in the creation of each human being than can be defined by even the most progressive research? (Perhaps the answers to both of questions might, paradoxically, be "yes." I wish to perform this inquiry in the tango costume.) The more I partake of the science/spirit interface, the more I have had to consider the unexpected possibility that a theological orientation could be equally appropriate as a scientific one for my inquiry into the myriad influences on the development of the fetus.

Yet, I am so excited by recent advances in the understanding of the significant role of maternal stress on fetal development and birth outcomes that I invited Curt Sandman, a leading neuropsychology researcher in this area, onto my doctoral committee. He and other groups have found that, for example, chronic stress in a pregnant mother leads (statistically, of course—not for each individual woman) to a host of negative outcomes, including preterm labor,[19] low birth weight, and irritable, temperamental babies.[20] Presumably, the chronic activation of the pregnant mother's stress axis, and the ensuing soup of stress hormones (which in excess will cross the placental barrier and impact the baby's developing system), results in adaptive changes in the baby's development on a cellular level. For instance, if a mother is constantly filled with anxiety, the "message" communicated to her baby is that they are in an unsafe environment (regardless of whether or not this is objectively true). The baby's cells will actually mutate (adapt) to prepare it for the unsafe environment into which it perceives that it will be born.[21] Sandman sees fetuses of stressed mothers developing better coping and survival skills, e.g., the ability to detect minute changes in the environment.[22] These fetuses also suffer decreased sensitivity in neural chemical receptors that modulate, for example, the experiences of pleasure and reward.[23] This makes sense: in a dangerous environment, stopping to smell the roses could leave one vulnerable to attack. These observations could well correlate with the hypervigilance, hyperarousal and tendency toward depression we see in those with prenatal trauma.[24] I am particularly intrigued by the finding of Sandman and his colleagues that it isn't just *any* kind of stress associated with these outcomes but, rather, pregnancy-related fears and anxieties.[25]

What is it about those pregnancy-related anxieties that would differentiate them from, say, work-related stresses? And could this realm of findings ultimately share a common thread with research which has found an association between unwantedness of the pregnancy and subsequent adult onset of schizophrenia in the offspring?[26] And how about other findings about the developmental sequelae of unwantedness? It has been found that babies whose conceptions weren't planned—whose mothers received the same quality of prenatal medical care as had the mothers of the planned babies—were 2.4 times more likely to die within the first 28 days of life than those babies whose conceptions had been planned.[27] At three months, planned infants showed higher levels of

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cognitive capacity and attachment to their mothers than did unplanned infants.[28]

What is one to make of such pre- and perinatal connections as that between traumatic birth procedures and subsequent suicide? [29] Bertil Jacobson has done fascinating research in Sweden on this topic, reporting a decade ago the significant correlation between the type of birth or prenatal trauma a person suffered and the method that person later used in suicide or suicide attempts. For instance, prenatal oxygen deprivation (fetal distress) correlated with suffocation or strangulation; "mechanical" trauma, such as the use of forceps, was associated with attempts to self-destruct with instruments such as guns; drug addiction was associated with opiate and/or barbiturate medication having been given to mothers during labor.[30]

I will venture even further out on that science/spirit limb (on which science is generally regarded as the more "solid, stable" research discipline, located as it is right next to the trunk of objective reality, with the "softer," more phenomenological, introspective, or even mystical ways of knowing way "out there" at the thinning edges) and ask what should be made of research that found, by separately hypnotizing and interviewing pairs of mothers and their teen or pre-teen children about events during pregnancy that had never been discussed with the children, that the amount of agreement between mothers and children about those events—i.e., the existence and accuracy of memories held by the children of those events, including such minutiae as the color and print of a dress worn in the second trimester—was astoundingly high? [31]

While there are studies suggesting that one likely common denominator in many processes of prenatally programmed vulnerability is abnormalities in the developing neuroendocrine axis[32]—which would be consistent with many undesirable outcomes following chronically stressed pregnancies—and there are biochemical explanations for memory,[33] I think that a hormone-dependent explanation of maternal-fetal influence is simply another twig on the brainism tree. In turn, I believe that the "brainism" phenomenon will one day soon back embryology into a corner, because of the question (among others) of "when does mind begin?" How many functioning neurons or axons or dendrites do we need before mind suddenly appears? It seems to me a thorny question to have to debate, and I second biologist Sewall Wright's notion (in specific reference to embryology) that "the emergence of even the simplest mind from no mind seems to me utterly incomprehensible." [34] That necessarily removes mind from the sole domain of the brain, leaving somewhat of a—yes—a mystery.

I am casting a pregnant mother in the paradoxical role of both external influence and internal experience of the fetus. As Cobb points out, this kind of recursive circuit undermines everything classical about physics and biology.

While the "brainism" framework has no room for a whole array of currently documented phenomena of mind without (or rather, before) brain,[35] a process theory embraces them, without having to revert to a wholesale dualistic framework. Beyond that, a process theology welcomes in the features of experience that have no corollary in science, but that are profoundly relevant to the processes of conception, pregnancy, and birth: the role of story and ritual; the noncognitive functions of religious models in evoking attitudes and encouraging personal transformation; the very notion of these basic life processes as *sacred*, and the type of personal involvement characteristic of religious faith. Just as I would hope that one day a heightened consciousness about creating and birthing children will be, "religion is *a way of life*." [36]

The human role in evolution

I find the research of Robert Jahn and Brenda Dunne at the Princeton Engineering Anomalies Research Laboratory (PEAR) to be very exciting. For the past thirty years, PEAR scientists have conducted tightly controlled studies which show that digital machines can be directly influenced by our intentions and consciousness. For example, a random event generator (REG) left unattended will produce a roughly equal distribution of **0**s and **1**s, consistent with the statistical expectation. However, when an operator (or even an inexperienced volunteer) is put in front of the machine and asked to "intend" either more **0**s or more **1**s to be produced, a small but tangible effect on the stream of digital information is produced. While these effects have historically been referred to as "anomalies," Jahn and Dunne write:

> [T]he empirical case is already strong enough to warrant reexamination of the prevailing position of science on the role of consciousness in the establishment of physical reality, with the goal of generalizing its theoretical concepts and formalisms to accommodate such consciousness-related effects as normal, rather than anomalous phenomena.[37]

As a scholar who is devoted to the idea that the consciousness of a pregnant mother (as well as, to a lesser extent, that of other close persons) has a profound effect upon the psyche and soma of her developing child, I am used to holding some of the most radical views among my lay and scholarly peers. Suddenly, in light of mind-matter research such as this from PEAR, my ideas seem positively quaint. Here before me is a gift of interdisciplinarity, a compelling—though still far from mainstream—new platform on which to build a case for an expanded vision of progressive prenatal care: if machines can be affected by a person's intention,[38] how much more can a developing fetus be influenced by the consciousness of its mother and father? (And besides, in the current mechanistic, "brainist" climate, isn't the entrenched, prevailing view of the fetus pretty much one of a machine-under-construction?)

Let me entertain for a moment the possibility that—through her peaceful, loving consciousness of welcome, safety and support for its highest unfolding of self—a pregnant mother can, even subtly, influence her developing baby toward a more secure, grounded, and "wired-for-love-rather-than-fear" experience of self. That this is the case has been supported by both NIH-funded, mainstream research,[39] as well as by "softer" research,[40] through which it has been shown that the attitudes and feeling states of the pregnant mother and her partner carry lifelong implications for her child.

What a powerfully emergent process, through which we, as "created co-creators,"[41] can participate in the ever-escalating complexity, the ever-higher-reaching consciousness of Teilhard's holy and scientific *evolution*![42] Here I reach back to Lamarck—a biologist before his time, dismissed then, but increasingly relevant now—and the significant role in evolution which he assigned to an organism's own efforts and interior life, the "within of things," and more recently to biologist Alister Hardy's contention that modern biology has privileged the mechanical role of external forces, acting on random mutations, over that of internal drives, including the "psychic life" of the organism, which he sees as a "most powerful creative element in evolution."[43] In applying these notions, I am casting a pregnant mother in the paradoxical role of both external influence as well as part of the internal experience of the fetus. As Cobb points out, this kind of recursive circuit undermines everything classical about physics and biology; when something can be both its own cause and effect, this portends a revolution in rationality.[44]

One of the revolutionaries, from the decidedly rear-guard field of biology, is cell biologist Bruce Lipton, whose work on inflammation as a Pathology Fellow at Stanford University's School of Medicine has yielded subversive information on the molecular nature of consciousness and human evolution. His focus, like that of researchers in so many scientific disciplines, is on the communication of information and its impact on the organism. His findings on "adaptive mutation"—primarily with work on bacteria, which will mutate genes to accommodate environmental stresses—support Lamarck's views of an organism's role in its evolution.

> If bacteria can do that, humans can do it infinitely better. It is fundamental to survival.... Adaptive mutation recognizes that it isn't just the environment that produced the change, but it's the organism's *perception of the environment* that determines the type of change that unfolds. This is extremely important, especially in humans. Lower animals have little room for interpretation. When you get to higher organisms, which have more awareness, a learning bias can insert itself between the real environment and the organism. This bias becomes our perceptions.... In prenatal development, the perceptions and beliefs of the fetus are really the same perceptions and beliefs as the mother—and there are very good reasons for it. When you're developing a new organism, it has to survive in the world that it's coming into.... The fate of a child is impacted by the mother's perceptions of her environment. If we recognize this we can find ways to increase the experiences which give rise to more healthy offspring.[45]

So that we might assist life, in theologian John Cobb's words, as it "exert[s] its gentle pressure everywhere, encouraging each thing to become more than it is."[46] An emergent process, creation unfolding, not reducible to formulae: *a mystery*.

"Mystery" brings me back to the tango man/woman. To extend perilously my working metaphorical tango image, perhaps beneath the masculine half of the costume the wearer sports a silky underthing, and beneath the feminine half, some Calvin jockeys, and so on, and so on: an infinitely layered event of polarities. The "two halves" of this one person will have exactly the same objective experience on a given evening, but—based upon which of the two halves through which the wearer is regarding a particular moment—may perceive and report them in very different ways, using different terms and perspectives. Will not both be valid? Will not both be *valuable* to a holistic understanding of the experience?

Such wide-ranging findings as are brought to bear in a broad understanding of pre- and perinatal development mandate that we keep dancing the entire floor in our tango suits, that we remain alert to findings which might be more readily noticed from a more "spiritual" or a more "scientific" orientation. I find myself having to qualify those differentiations with quotation marks as I become increasingly steeped in an ever more integrated view of science and spirit. The separation between the two is ultimately an artificial and arbitrary one, although prevalent and seductive. The deeper one delves into the historical trajectories of scientific and spiritual ways of knowing, the harder it is to draw that line between them. Rather, it becomes more of a permeable membrane, through which orientations and insights can flow back and forth. The seam of the tango costume. What if, instead of two halves of a costume with a seam down the middle, we were to imagine all the colors and textures of both aspects of that costume captured in a variegated thread; and what if, with that long, single strand of multi-hued, multi-textured fiber, there was knitted together a wondrous cape for a researcher to don? And from inside that cape the seeker of knowledge will embrace stories and statistics, images and empirical data, and will ever retain a sense of awe for the continuous unfolding of creation, in all its forms. And, above all, this seeker will have the power to regard something yet unexplained, something yet a mystery, and say—simply, and without a trace of defeat or antagonism—"I wonder."

Works Cited:

Anokhin, D. V. "Molekuliarnye stsenarii konsolidatsii dolgovremennoi pamiati." ["The molecular scenarios of the consolidation of long-term memory."] *Zh Vyssh Nerv Deiat Im I P Pavlova* 47, no. 2 (1997): 261-79.

Arnold, Matthew. "Morality." In *Empedocles on Etna, and Other Poems*. London: B. Fellowes, 1852.

Barbour, Ian G. *Religion and Science: Historical and Contemporary Perspectives*. San Francisco: HarperCollins, 1997.

Barker, D. J. P., ed. *Fetal and Infant Origins of Adult Disease*. London: British Medical Journal, 1992.

Bouchard, T. J., Jr., D. T.. Lykken, M. McGue, and A. Tellegen. "Intrinsic and extrinsic religiousness: Genetic and environmental influences and personality correlates." *Twin Research* 2 (1999): 88-98.

Bustan, M. N., and A.L. Coker. "Maternal attitude toward pregnancy and the risk of neonatal death." *American Journal of Public Health* 84, no. 3 (1994): 411-14.

Chapouthier, G, and A. Ungerer. "Bases biochimiques de l'apprentissage et de la memoire." ["Biochemical bases of learning and memory."] *Encephale* 62, no. 5 (1973): 408-26.

Cheek, David B. "Are telepathy, clairvoyance and 'hearing' possible in utero? Suggestive evidence as revealed suring hypnotic age-regression studies in prenatal memory." *Pre- and Perinatal Psychology Journal* 7, no. 2 (1992): 125-38.

Clark, P. M. "Programming of the hypothalamo-pituitary-adrenal axis and the fetal origins of disease hypothesis." *European Journal of Pediatrics* 157, Suppl. 1 (1998): S7-10.

Cobb, J. J. *Cybergrace*. New York: Crown, 1998.

Hamer, D., and P. Copeland. *Living With Our Genes: Why They Matter More Than You Think*. New York: Doubleday, 1998.

Hefner, Philip. *The Human Factor: Evolution, Culture, and Religion*. Minneapolis: Fortress Press, 1993.

Insel, Thomas, C. Kinsley, P. Mann, and R. Bridges. "Prenatal stress has long-term effects on brain opiate receptors." *Brain Research* 511 (1990): 93-97.

Jacobson, B, G. Eklund, L. Hamberger, D. Linnarsson, G. Sedvall, and M. Valverius. "Perinatal origin of eventual self-destructive behavior." *Pre-and Perinatal Psychology Journal* 2, no. 4 (1988): 227-41.

Jahn, R. G., and B. J. Dunne. *Margins of Reality: The Role of Consciousness in the Physical World*. New York: Harcourt Brace Jovanovich, 1988.

Janus, Ludwig. *The Enduring Effects of Prenatal Experience: Echoes from the Womb*. Northvale, N.J.: Jason Aronson, 1997.

Lipton, Bruce. "Nature, nurture and the power of love." *J of Prenatal and Perinatal Psychology and Health* 13, no. 1 (1998): 3-10.

Lynch, A. *Thought Contagion: How Belief Spreads Through Society*. New York: BasicBooks, 1996.

McKellan, Ian. Interview in the series, "Inside the Actors Studio." 1999. © Bravo, the Film and Arts Network, a subsidiary of Rainbow Programming Holdings, Inc.

Montemurro, Rosario N. Rozada. "Singing lullabies to unborn children: experiences in Village Vilamarxant, Spain." *Prenatal and Perinatal Psychology Journal* 11, no. 1 (1996): 9-16.

Myhrman, A., P. Rantakallio, M. Isohanni, and P. Jones. "Unwantedness of a pregnancy and schizophrenia of a child." *British Journal of Psychiatry* 169 (1996): 637-40.

Paneth, N. S. "The problem of low birth weight." *The Future of Children* 5 (1995): 1-13.

Radin, D. *The Conscious Universe*. New York: HarperSanFrancisco, 1997.

Rini, C. K., C. Dunkel-Schetter, P. D. Wadhwa, and C. A. Sandman. "Psychological adaptation and birth outcomes: the role of personal resources, stress, and sociocultural context in pregnancy." *Health Psychology* 18, no. 4 (1999): 333-45.

Roe, K. V., and A. Drivas. "Planned conception and infant functioning at age three months: a cross-cultural study." *American Journal of Orthopsychiatry* 63, no. 1 (1993): 120-25.

Salk, L., L. P. Lipsitt, W. Q. Sturner, B. M. Reilly, and R. H. Levat. "Relationship of maternal and perinatal conditions to eventual adolescent suicide." *Lancet* 1 (1985): 624-27.

Sandman, C. A, and N Yessaian. "Persisting subsensitivity of the striatial dopamine system after fetal exposure to beta-endorphin." *Life Sciences* 39 (1986): 1755-63.

_____, Pathick D. Wadhwa, Christine Dunkel-Schetter, Aleksandra Chicz-DeMet, Judy Belman, Manuel Porto, Yuji Murata, Thomas J. Garite, and Francis M. Crinella. "Psychobiological influences of stress and HPA regulation on the human fetus and infant birth outcomes." *Annals of the New York Academy of Sciences* 739 (1994): 198-210.

Sonne, John. "Interpreting the dread of being aborted in therapy." *J of Prenatal and Perinatal Psychology* 11, no. 4 (1997): 185-214.

Tellegen, A., D. T. Lykken, D., T. J. Bouchard, Jr., K. J. Wilcox, N. L. Segal, and S. Rich . "Personality similarity in twins reared apart and together." *Journal of Personality and Social Psychology* 54 (1988): 1031-39.

Verny, Thomas, and John Kelly. *The Secret Life of the Unborn Child.* New York: Delta, 1981.

_____, and Pamela Weintraub. *Nurturing the Unborn Child.* New York: Dell, 1991.

Wade, Jenny. "Two voices from the womb: evidence for physically transcendent and a cellular source of fetal consciousness." *Journal of Prenatal & Perinatal Psychology & Health* 13, no. 2 (1999): 123-47.

Wadhwa, P. D. "Prenatal stress and life-span development." In *Encyclopedia of Mental Health,* ed. by H. Friedman, 8-10. San Diego: Academic Press, 1988.

_____, C. Dunkel-Schetter, A. Chicz-DeMet, M. Porto, and C. A. Sandman. "Prenatal psychosocial factors and the neuroendocrine axis in human pregnancy." *Psychosomatic Medicine* 58, no. 5 (1996): 432-46.

Wolfe, Tom. "Sorry, But Your Soul Just Died." In *Hooking Up*, 89-109. New York: Farrar, Straus and Giroux, 2000.

_____. "Digibabble, Fairy Dust, and the Human Anthill." In *Hooking Up*, 66-88. New York: Farrar, Straus and Giroux, 2000.

Zimberoff, Diane, and David Hartman. "Insidious trauma caused by prenatal gender prejudice." *Journal of Prenatal and Perinatal Psychology and Health* 13, no. 1 (1998): 45-52.

Endnotes:

1. Barbour, p. 73, for example.

2. Cobb, p. 53. English philosopher Alfred North Whitehead, father of process philosophy, after devoting much of his professional energy to devising a metaphilosophy of mathematics based on logic, ultimately concluded that logic could not fully explain the fundamental nature of reality, and that our world ultimately contained a nonlogical element, which he called a "God-shaped hole."

3. See n. 2.

4. Quoted in Barbour, p. 59. Note Darwin's grammatical deification of science, with the capital "S."

5. Ibid.

6. Ibid.

7. Process thought views reality as a dynamic web of interconnected events, with nature characterized by change, chance, and novelty as well as order. God interacts reciprocally with the world, an influence on all events though never the sole cause of any event. Every new event is the joint product of the entity's past, its own action, and the action of God. Thus, creation is a long, incomplete, continuously unfolding process, all forms of which are seen as divinely persuaded.

8. Cobb, pp. 82-83.

9. Ibid., p. 39.

10. Barbour, p. 86.

11. Cobb, p. 94.

12. Ibid., p. 197.

13. Ibid., p. 171.

14. Wolfe, "Sorry, But Your Soul Just Died," p. 89.

15. Wilson, quoted in Barbour, p. 80.

16. Hamer, p. 314.

17. Wolfe, "Digibable, Fairy Dust, and the Human Anthill," p. 87.

18. This whimsically fabricated, hypothetical example of twins' similarities pales in comparison to the many astonishing actual accounts that have emerged in the identical-twins-separated-at-birth literature. In one famous example, the "Jim Twins," among the first group of identical twins reared apart studied by the Minnesota Center for Twin and Adoption Research, met after 39 years and discovered that they both drove the same model of blue Cheverolet, chain-smoked Salems, chewed their fingernails, owned dogs named Toy, and took vacations to the same stretch of beach in Florida (Tellegen et al.). More recent findings go on to suggest a genetic basis for such seemingly volitional tendencies as novelty-seeking and religiousness (Bouchard et al.). As compelling as this body of research is regarding the inviolable predetermination of genetics, I would point to the equally compelling existence of countless raised-together identical twins who—presumably through conscious choice, yes, *free will*—cultivate and pursue individual and very different identities.

19. Preterm labor, or short gestational age, is the principle determinant of low birth weight—a phenomenon of largely unknown etiology—which in turn carries with it many long-term developmental risk factors, and has more recently been identified as a potent risk factor for cardiovascular disease, hypertension, and type II diabetes. It is stunning to note that in the United States, with our considerable technological and medical prowess, neither the low birth weight rate nor the preterm delivery rate has improved in the past quarter century.

20. Rini et al.

21. Lipton.

22. Sandman et al.

23. Insel et al.; Sandman and Yessaian.

24. Janus.

25. Rini et al.

26. Myhrman et al.

27. Bustan and Coker.

28. Roe and Drivas.

29. Salk et al.

30. Jacobson et al.

31. Cheek.

32. Clark; Wadhwa et al.

33. Anokhin; Chapouthier and Ungerer. I believe, however, that an in-utero memory of an ex-utero circumstance would severely strain a biochemical explanation; this phenomenon falls more likely in the realm of telepathy and other non-local phenomena.

34. Barbour, p. 236.

35. Cheek; Sonne; Wade.

36. Barbour, p. 236; emphasis in the original.

37. Jahn and Dunne, p. 148. Similar mind-matter interaction effects have been repeatedly observed in nearly five hundred dice and RNG experiments for more than five decades. A 1987 meta-analysis of 832 RNG studies conducted by sixty-eight investigators, including 597 experimental and 235 control studies (of which just 258 of the experimental and 127 of the controls were part of PEAR's ongoing investigation) found that experimental results produced odds against chance beyond a trillion to one, while control results were well within chance levels with odds of two to one. "The assertion that other labs have not obtained Jahn's results is a commonly repeated skeptical mantra, but it is also false.... Jahn's results are entirely consistent with a larger body of evidence collected by more than seventy investigators, and overall there is no question that replication has been achieved. If anything, Jahn's results are some-

what smaller in magnitude than those reported by others" (Radin, p. 225).

38. Psychologist William Braud has done extensive mind-matter interaction studies within the human realm, in which subjects influenced various physiological systems of distant individuals through mental intention; see Radin, p. 225.

39. Bustan and Coker; Insel et al.; Sandman et al.; Wadhwa.

40. Montemurro; Sonne; Verny and Kelly; Verny and Weintraub; Zimberoff and Hartman.

41. Hefner, ch. 3.

42. Cobb, p. 81.

43. Barbour, p. 223.

44. Cobb, p. 61.

45. Lipton, p. 6; emphasis added.

46. Cobb, p 56.

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Metaphor and Apophatic Discourse: Putting Sells in Dialogue with Lakoff and Johnson

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In the book, Mystical Languages of Unsaying, *Michael A. Sells presents a performative theory of apophatic discourse. His idea is that apophatic discourse functions as a semantic analogue to mystical experience through "meaning events." Although he acknowledges that an appreciation of the subtleties of metaphor is crucial to an understanding of mystical language, Sells does not discuss the extensive literature on metaphor theory from the last few decades. In this essay, the author explores how George Lakoff and Mark Johnson's theory of metaphor may enrich Sells' theory. Further, he addresses what Lakoff and Johnson may learn from Sells' treatment. While there are no conflicts, strictly speaking, between the metaphysical pictures suggested by the two theories, Sells' picture of the world allows for fissures of meaning at which Lakoff and Johnson's theory at best hints. Ultimately, Lakoff and Johnson's conception of metaphor requires that Sells' theory of apophatic discourse be reexamined.*

Sells on apophatic discourse

In *Mystical Languages of Unsaying*, Michael A. Sells presents a novel theory of mystical language. Sells' view is that mystical language is used (by mystics) *performatively*, in some sense of the word.[1] The goal of the use of mystical language is, then, to produce a type of semantic event. Sells calls this a "meaning event."[2]

> Meaning event indicates that moment when the meaning has become identical or fused with the act of predication. In metaphysical terms, essence is identical with existence, but such identity is not only asserted, it is performed.... The meaning event is the semantic analogue to the experience of mystical union. It does not describe or refer to mystical union but effects a semantic union that re-creates or imitates the mystical union.[3]

To understand sentences as discrete propositions, abstracted from mystical texts or practices, is to misunderstand importantly such expressions. Rather than interpreting negating or apophatic utterances alone, one must understand them against some affirmative, or kataphatic, backdrop. In such a context, apophatic expressions cause a semantic break. This fissure, then, is the emergence of the (real) meaning of the apophatic discourse. It is this meaning to which the apophatic and kataphatic expressions (working in concert) were directing the cognizer. Sells speaks of this as an anarchic use of language,[4] and the political metaphor is quite apt. After all, one would not use the term anarchy to describe a chaotic social arrangement generally, but, rather more appropriately, an established social order that has broken down in some manner. It is against such a background that anarchy distinguishes itself (it also has another, against which to be defined). Similarly, with apophatic language, it is the backdrop of affirmative expressions that provides for negations having meaning (if not content, as such). This is what Sells means when he writes:

> The meaning event occurs within a kataphatic theological context. The apophatic language itself contains a strongly mimetic aspect, that is, through particular stratagems (such as "withdrawing" the subject from a subject-predicate proposition), it aims to induce within the reader an event that will

emerge from the kataphatic context (such as the notion of awakening), but which in itself refuses subject-predicate dichotomy (an awakening without awakener). The moment of fusion of subject and predicate is ephemeral; the awakening without awakener soon reifies into just another object of experience. The writer must continually turn back to unsay the previous saying.[5]

A methodological point needs to be clarified before I can go further. I refer to Sells' theory of mystical language, but that may be misleading. Sells does not wish for his views on mystical language to be understood as a formula to be applied.[6] Rather, he characterizes it as a "schematic and formal outline."[7] It is difficult to understand what Sells means by this distinction, but I interpret it to mean that Sells is generating a fallible hypothesis about mystical language, a work-in-progress. With a rough idea of Sells' theory in mind, I move on to an exploration of how it accounts for a variety of mystical texts.

The "positive nothingness," which is Eriugena's view of deity, is one that enables reason itself to be pious. But as is seen in the dialogue between the nutritor and the alumnus, this rational piety is never achieved once and for all.

The mystical texts Sells explores vary in terms of their philosophical versus their devotional content. This is not to indicate that any of these texts are purely one or the other. Rather, some of the authors Sells discusses seem to have had a scholarly audience in mind, while others seem to have had a religious audience (insofar as these may be understood to be separate). I consider Plotinus and John the Scot Eriugena to belong to the former, while Marguerite Porete and Meister Eckhart belong to the latter. This distinction will be largely glossed over in what follows. However, a truly comprehensive study would need to observe this important distinction among apophatic writers. In order to illustrate how Sells draws on both types of writers, I focus my analysis of his theory upon his treatment of two of them: Eriugena and Porete.

Eriugena's apophatic theology, found in his *Periphyseon*, embodies much of Sells' theory of apophatic discourse. For example, a central thesis in Sells' theory is that expressions of apophasis ought not be taken out of context in a discourse. This is what he means by Double Propositions.

> No statement about X can rest as a valid statement but must be corrected by a further statement, which must itself be corrected in a discourse without closure.[8]

Eriugena writes the *Periphyseon* as a dialogue between a "nutritor" (an established philosopher) and an "alumnus" (a novice).[9] In the very structure of Eriugena's writing can be seen this dialectical mode of creating mystical meaning.

Sells observes that Eriugena relies significantly upon Pseudo-Dionysius' mystical theology and states that Pseudo-Dionysius privileges apophatic discourse.[10] Can the alumnus be thought of as the voice of kataphatic theology? I believe it would be too simplistic to do so, but there would be a point to such a characterization. The nutritor is well aware of both kataphatic and apophatic moods in expressions about God. However, the alumnus states such kataphatic moods more emphatically (and exclusively). Sells writes of the tension that emerges in this dialogue:

> A true drama is unfolding within the technical language and academic niceties. Not the least element in that drama is the sense that at this point in the dialogue the nutritor and alumnus have become equals in the discussion,

> pushing it toward a conclusion it might not have reached had the nutritor merely propounded his own preconceived ideas.[11]

It is this drama which a theory of mystical language seeks to take note of—what happens in virtue of the articulation of Double Propositions.

This is where the term *agnosia* is useful in studying apophatic language. Sells describes *agnosia* as "an unknowing that goes beyond rather than falling short of kataphatic affirmations."[12]

> This *agnosia* begins with the contemplation (*theōria*) of the "place" of the deity beyond all gaze or contemplation.[13]

Agnosia functions against the backdrop of what is known. It is awareness of a "positive nothing" rather than a "negative nothing," about which Peter Hawkins and Anne Howland Schotter write:

> If the ineffable is that about which nothing truly can be said, perhaps (to borrow a line from Wallace Stevens's "Snowman") we can differentiate between "the nothing that is not there and the nothing that is"–between what we may call a "negative" ineffable and a "positive" one.[14]

It is this "positive nothing" (or ineffable) to which apophatic discourse intends to draw attention. This is the awareness of a fullness, a transcendence—not a mere lack of presence. Sells writes:

> In Dionysius and Gregory of Nyssa, Eriugena found an alternative to the substantialist view of deity propounded by the Church councils, which had consistently applied the term ousia (substance, being) to the nature(s) of Christ and to the trinity, and which through the writings of Augustine had become central to the Western Christian tradition. Within the *Periphyseon*, Eriugena integrated into his own apophatic discourse both Dionysius' affirmation that the deity was "beyond-being" and Gregory's suggestion that the "nothing" (*creatio ex nihilo*) was the divine nothingness out of which all being proceeds.[15]

The "positive nothingness," which is Eriugena's view of deity, is itself to be pious. But as is seen in the dialogue between the nutritor and the alumnus, this rational piety is never achieved once and for all. Rather, this sense of piety creates fissures in an otherwise reified, kataphatic view of deity and faith. The nutritor warns the alumnus that these fissures can be reified themselves and become obstacles to such piety. Indeed, the nutritor, seemingly anticipating some of the insights in contemporary metaphor theory, suggests to the alumnus that even the apparently innocuous use of prepositions can have unfortunate consequences. Sells writes:

> It would be easy to dismiss such a concern with the minutiae of grammar and with what might seem an unduly literal reading of a preposition. For the nutritor, however, such a summary dismissal has serious consequences. The delimitations of language become invisible and consequently more powerful and destructive. At issue is the dependence of thought upon language. To claim that such language should not be taken spatially is to ignore the power of language. The spatial element in a preposition cannot be willed away as if it were not fundamental to the word. As the dialogue proceeds, the nutritor will insist that to believe such spatial connotations can be willed away is to become all the more vulnerable to what he will call the "monstrous and abominable idols" hidden within such language.[16]

It is here that Lakoff and Johnson have the most to offer Sells' theory. However, their insights require some rethinking of Sells' theory of mystical language.

Another important mystic discussed by Sells is Marguerite Porete. All too often overlooked or neglected and negated,[17] Porete's mystical writings provide another field of complex metaphors and apophatic expressions with which a theory such as Sells' may deal. That such a text could provoke such strong reactions would make it worth study on its own; however, insofar as it is an under-explored text in Western mysticism, it will provide a novel example for Sells' theory to explain.

> Any act done as a means (*moyens*, *intermedium*) or as a use (*usage*, *usum*) is a "work," which entails an enslavement to the will. What might seem an

> unexceptional doctrine of salvation through faith rather than works is then pushed to the extreme: the soul that gives up all will and works is no longer concerned with poverty or riches, honor or dishonor, heaven or hell, with self, other, or deity. Such a state of utter selflessness, or annihilation of the will and reason—both of which are concerned with works—cannot be achieved through works or effort. It occurs when the soul is taken up or ravished (*ravie, rapta, ravissee*) by its divine lover.[18]

What impact do love and desire have upon one's encounter with the loved or desired other? This image of transforming love brings to mind Martin Buber's distinction between I-Thou versus I-It modes of experiencing the world. In the former, the subject is constituted in virtue of the relationship, whereas in the latter the subject is constituted prior to the experience of the object (which is not considered here as an "other," but merely as an "it"). This similarity does not invite a rash accommodation of Porete's late medieval work to that of a twentieth-century philosopher-theologian. Porete's work lies in a long tradition of apophatic writers who were profoundly struck by the encounter with transcendence. This encounter effected a strong pious response with respect to the Other. However, while a thinker like Buber explored this relationality somewhat abstractly, Porete explored the encounter with the transcendent in erotic metaphors.

Lakoff and Johnson's theory of metaphor begins with a simple idea whose scope of application is quite large: metaphors make up some of the most basic and pervasive uses of language we have, including philosophical and theological uses of language.

As does Eriugena's work, Porete's text, *The Mirror of Simple Souls*, takes the form of a dialogue. Sells observes:

> *The Mirror of Simple Souls* is a book of 122 chapters, most of it a dialogue of courtly love carried out among a group of personified characters. The principal participants are Lady Love (*Dame Amour*), also called Her Highness Amour, and the Enfranchised Soul (*l'ame enfranchie*), also called the Annihilated Soul, or simply, the Soul. [...] The central event of the drama is the death of Reason who, after continued questioning of Dame Amour over the paradoxes of love, finally dies (chap. 87), "mortally wounded by love." This theatrically constructed event marks a major transformation in the annihilated soul, who is now freed from reason and able to "reclaim her heritage."[19]

Note the similarities present here between Porete's dialogue and that of Eriugena in the *Periphyseon*. Note the similarities between the questioning roles of Reason and of the alumnus. Both function as foils against which the apophatic view is contrasted. In both cases, the use of a dialogue emphasizes a dramatic element to the transcendent encounter. Also in both cases, the stakes of the dialogue are quite high. The nutritor is aware of this when the power dynamics between himself and the alumnus have been equaled. The stakes are much higher in Porete's dialogue (as Reason loses its life). Moreover, after the death of Reason, the soul is "free" to "reclaim her heritage."

Sells cautions against misunderstanding Porete's work as merely asserting the priority of faith over works in attaining salvation in the Christian mythos.

> A work is any act carried out through one's own will. [...] The harder the soul attempts to transcend will, the more she becomes entrapped in it; the more she works to transcend works, the more she is enslaved to works. From such a dilemma, reason can find no way out.[20]

This is where apophatic moves come in. By saying that reason cannot find a way out of this dilemma, what is being said is that further information, or deductions performed on information already attained, will not solve the problem. This is why reason must "die." This is not to say that reason has no helpful role to play. Following Sells' suggestions, it is against the context of rationality (propositional truth and rational inquiry) that apophatic moves attain their dramatic performance. The tendency to view assertions exclusively individually, as discrete propositions, is the problem. Instead, it is through silencing reason (not once and for all, but as an admonishing) that the will shall be transcended. Sells writes,

> Dame Amour conceives of grace as divine love, which is nothing other than deity itself. This love allows the soul to become "disencumbered" of its will and works, and thereby, of its own self. Only when the soul's own being and will are annihilated can the deity work through and in it.[21]

There is a paradox here. The implication is that the soul's being and will are obstacles in the way of the deity's working in and through the soul. But, as Sells goes on to point out, only the deity itself can remove these obstacles. The soul cannot will to annihilate its own being and will. Such can only happen by the grace of divine love. Moreover, Sells writes that Porete's view is "an understanding of the annihilated soul [that] cannot be found in scripture, that human sense (*sensus*) cannot apprehend it, nor human work merit it. It is a gift...."[22] Given the context of the relationship between the annihilated soul and the deity as an erotic relationship, it seems appropriate to note that an important precondition for such a relationship is trust. What seems implied in this analogy is a manner of living where the pious adherent seeks after no longer seeking. Most importantly, this aporia of the will is embraced through Porete's dissolution of the self as a discrete entity. In mystical union, the self is lost in the deity. The distinction between subject and object is now unsaid.

This "apophasis of desire" (in Sells' language) leads to a sense of abandon with respect to engaging in life.

> The soul's abandonment of discretion reflects a paradox found within courtly love. The rules of courtly love or "courtesy" (*cortezia*) demand discretion, conforming to the conventions and norms of society, and *mezura*, avoiding of excesses of feeling and behavior. Yet the courtly lover (*fin aman*) continually violated these standards of *cortezia* and *mezura* and acted in a solitary, excessive manner. Porete has combined this language of cortezia with an apophatic language of mystical union. The union-with-and-in-love is *rapture*. Rapture is the act and work of love. The language of rapture includes a complex of interdependent terms and figures of speech (disrobing, nakedness, loss of discretion, loss of shame, abandon) that reinforce the basic sexual metaphor. As Dame Amour said, there is no "discretion" in love. The soul gives up her honor, her shame. She disrobes herself of will. Her union with the divine lover occurs in nakedness. She gives herself over to abandon. She "falls" (in an expression that will have many levels of meaning) into love.[23]

Again, note the similarities between "abandon" and "rapture" in Porete's idiom and anarchy in Eriugena. In both cases, there is a rupture or break from "rational" or factual, propositional uses of language. In fact, especially in the metaphor of a sexual relationship between the soul and the divine lover, one sees how anemic reason (propositional discourse) really is. The trust and rapture of the lover for its other are basic; the use of reason would be as a helper to such a relationship. I am reminded here of Nietzsche's famous opening to *Beyond Good and Evil* (in that case, the cold reason of the philosopher is compared to the need for passionate pursuit of truth).

Porete's apophatic treatment of desire relies upon a kataphatic tradition of faith and works. Again, mystical insights become possibilities when instantiated within the context of a structure of symbols. The rapture of mystical union (if such may be spoken of as a discrete referent) is possible only through the process of negation or abstraction from the reifying force of language. Here is where further exploration of these themes will benefit from a discussion of Lakoff and Johnson's contemporary theory of metaphor. Their conception of embodied reason will shed light upon why using these metaphors can be so useful at providing dramatic experiences of the divine. However, as I note in my conclusion, Lakoff and Johnson's findings require a rethinking of some of Sells' ideas about apophatic discourse.

Lakoff and Johnson's theory of metaphor

George Lakoff and Mark Johnson's theory of metaphor begins with a simple idea whose scope of application is quite large. The idea is this: metaphors are not parts of speech whose function is the exception to the rule of literal uses of language. Rather, metaphors make up some of the most basic and pervasive uses of language we have, including (and in the context of this essay, especially) philosophical and theological uses of language.

> Metaphor is for most people a device of the poetic imagination and the rhetorical flourish—a matter of extraordinary rather than ordinary language. Moreover, metaphor is typically viewed as characteristic of language alone, a matter of words rather than thought or action. For this reason, most people think they can get along perfectly well without metaphor. We have found, on the contrary, that metaphor is pervasive in everyday life, not just in language but in thought and action. Our ordinary conceptual system, in terms of which we both think and act, is fundamentally metaphorical in nature.[24]

Interestingly, many of the ideas found in their work is reminiscent of the insights of several of the mystics Sells studies. Both these mystics and Lakoff and Johnson are aware of the non-triviality of metaphor in everyday language. Both develop sophisticated systems for appreciating how metaphors reveal worldviews. Lakoff and Johnson's system turns on the idea of metaphorical mapping.

Since their seminal work two decades ago, *Metaphors We Live By*, Lakoff and Johnson's metaphorical theory has undergone some development. Advances in the cognitive sciences have warranted some adjustments in the theory. These adjustments generally have to do with developments regarding how best to think about so-called mental content (i.e., as being basically propositional in content or as being activation patterns across neural networks). I refer to the conceptual version of the theory as the "old" theory, and the neural network version of the theory as the "new" one. For their part, Lakoff and Johnson seem willing to embrace the advances in neural science via their new theory. However, the basic insight of the theory remains the same: cross-domain conceptual mappings are pervasive in human thought. But just what is a cross-domain conceptual mapping? Lakoff and Johnson write:

> Primary metaphors, from a neural perspective, are neural connections learned by coactiviation. They extend across parts of the brain between areas dedicated to sensorimotor experience and areas dedicated to subjective experience. The greater inferential complexity of the sensory and motor domains gives the metaphors an asymmetric character, with inferences flowing in one direction only.
>
> From a conceptual point of view, primary metaphors are cross-domain mappings, from a *source domain* (the sensorimotor domain) to a *target domain* (the domain of subjective experience), preserving inference and sometimes preserving lexical representation. Indeed, the preservation of inference is the most salient property of conceptual metaphors.[25]

The parallels between the old and new theories can be seen here. At this juncture in the cognitive sciences and in the philosophy of mind, it is probably best to develop parallel expressions of a theory (along the lines seen in Lakoff and Johnson's theory) that involve rationality. The entailments of one expression may not precisely match up with the other—and in many cases this will be very useful. The old expression of the theory allows for greater integration into other conceptual theories. Likewise, the new expression of the theory allows for greater connections with the neural sciences. I will use the old, conceptual, expression of the theory, given that the integration taking place in this paper is between metaphor theory and an appraisal of a theory of mystical language.

The basic idea in Lakoff and Johnson's theory of metaphor is that concepts from the sensorimotor domain of experience are often used to understand conceptual domains involving subjective experience. But what do Lakoff and Johnson mean by "subjective" here? It may be helpful to think of such domains as more or less removed from the senorimotor domain of experience. That is, target domains are conceptual domains which are comparatively abstract. The idea is that one may use the structure of sensorimotor conceptual domains to understand something of the structure of more abstract concepts. An example of such a mapping is their much-used "Life Is A Journey" metaphorical mapping.[26] Recognizing the contingency of this mapping, they now refer to it as "A Purposeful Life Is A Journey" metaphor. Not everyone thinks of life as a journey. However, making this aspect of the metaphor explicit was not truly necessary. The central point of Lakoff and Johnson's theory is to reveal just how pervasive (and optional, even when pervasive) cross-domain conceptual mappings really are. Some of the constituent metaphors that play a role in the "A Purposeful Life Is A Journey" metaphor are as follows:

"A Person Living A Life Is A Traveler"
"Life Goals Are Destinations"
"A Life Plan Is An Itinerary"[27]

These constituent metaphors work together in concert, providing an array of concepts with which to conceptualize what a purposeful life is. This particular cross-domain mapping has become quite pervasive in American culture. It is somewhat surprising to learn that it is an optional mode of understanding life. However, cross-domain conceptual mappings are important for an additional reason, as Lakoff and Johnson write:

> Perhaps the most important thing to understand about conceptual metaphors is that they are used to reason with. The Love Is A Journey mapping does not just permit the use of travel words to speak of love. That mapping allows forms of reasoning about travel to be used in reasoning about love. It functions so as to map inferences about travel into inferences about love, enriching the concept of love and extending it to love-as-journey.[28]

What this suggests is that a person does not merely conceptualize subjective conceptual domains by means of sensorimotor domains; rather, what a person learns about such subjective domains may depend critically upon what source conceptual domain was used in order to structure the target domain. Given that these mappings are contingent, what a person learns will be structured contingently as well. Lakoff has stated that this theory may be thought of primarily as one of cross-domain conceptual mappings, and secondarily as a theory of metaphor (insofar as metaphors are instantiations of the mappings).[29] However, since the mappings consist in understanding one class of terms by means of another class of terms, referring to it as a theory of metaphor is not entirely misleading.

Porete's work lies in a long tradition of apophatic writers who were profoundly struck by the encounter with transcendence. This encounter effected a strong pious response with respect to the Other.

This brings me to a part of Lakoff and Johnson's theory with which I have some problems: their theory of truth. Because of the culturally and bodily dependent nature of cross-domain mappings, Lakoff and Johnson argue that truth ought to be characterized in this way:

> A person takes a statement as "true" of a situation if what he or she understands the sentence as expressing accords with what he or she understands the situation to be.[30]

This is supplied as an alternative to correspondence theories of truth, but what do Lakoff and Johnson mean by the word "accords"? I am unsure of how this word is any better than (other than being different from) the word "corresponds." Moreover, Lakoff and Johnson refer to what a sentence expresses. It is this that accords with what is understood about a situation when a sentence is taken to be true of that situation. Perhaps "is consistent" would be a suitable substitute expression for "accords." However, if so, then Lakoff and Johnson would be left with a nonrealist account of truth (i.e., truth depends solely upon one's background beliefs). Also, it is often the case that what is most important in an inquiry is what one does not know or understand about a situation or state of affairs. This observation needs to be addressed. Surely, an adequate theory of representation (of which a theory of truth will be a part) needs to account both for the reality of a cognizer-independent world as well as the manner in which our concepts (especially cross-domain mappings) grasp and frame the world we encounter. However, this is not that theory. It satisfies the second requirement while neglecting the first. Lakoff and Johnson assert that they wish to have an embodied realist picture of the world: one steeped in the cognitive and natural sciences. This shows the reader something of a promissory note—that for which Lakoff and Johnson need to provide a theory of truth to explain. So long as their theory of truth does not appreciate this aspect of the meaning of truth—namely, that the world outruns our conceptualizations of it—it will be inadequate. Putting aside these qualms about their theory of truth, there is much I can accept about Lakoff and Johnson's theory of metaphor. In particular, I am inclined to adopt their theory of cross-domain mappings as quite illuminating of the nature of reason.

The insight of apophatic discourse, as well as of contemporary metaphor theory, is that how a person understands these abstract conceptual domains is optional. To view any conceptual mapping as necessary or essential is at best an exaggeration, and at worst an important mistake.

While Lakoff and Johnson seem to think that their theory of metaphor (and of reason in general) will upset the dominant Western paradigms—perhaps an over-expectation—their theory does provide a picture of embodied reason which is worth attention. What their theory reveals is that many philosophical and logical analyses of abstract concepts (such as time, causation, and meaning in life) have incorporated cross-domain metaphorical mappings. Thus, the chapter title, "The Cognitive Science of Philosophy," is rather provocative. If the point of philosophical inquiry is to gain perspective on a given subject matter, to understand the subject from the greatest point of generality, then an appreciation of metaphor theory will be crucial. However, such inquiry should not be undertaken too naively. Cognitive science is not a ready-made conceptual domain; it, too, has its rifts and areas of disagreement. An appreciative, but critical, stance toward the cognitive sciences is warranted. With that in mind, it is best to think of Lakoff and Johnson's theory as a good and powerful explanation of cross-domain mappings. However, the very disciplines of philosophy that they would dismantle have helped define and create the tools they they would use for the dismantling. Insofar as their approach instills a certain humility in the philosopher with respect to the question of getting to the "essence" of a subject matter, their view is helpful. However, forming opinions about the nature of these subjects may be likewise unavoidable. It may be that that which they critique is, in one important sense, *not optional.*

Enriching Sells' theory of apophatic discourse with Lakoff and Johnson's metaphor theory

What does Lakoff and Johnson's theory have to offer Sells' theory of mystical language? As mentioned above, Sells takes note of the novel metaphors and unique uses of prepositions found in mystical texts. What pictures are presupposed by such cross-domain mappings? Sells explores Eriugena's treatment of *creatio ex nihilo*. There are common readings of this idea:

> The temporal meaning implies that the creator exists prior to this creation, and that "nothing" was there prior to its becoming the creation into which it was made. [...] The spatial meaning and the material meaning are closely related. The word "from" relates a creator or maker to something outside of itself, to some kind of material or place out of which he fashions his creation.[31]

Eriugena appropriates Pseudo-Dionysius' view of emanation as overflow. Sells writes of this:

> Thus the *logos* flows into all things (the spatial metaphor is exposed), it flows them into being (the metaphor of diffusion), and it overflows them, i.e., it transcends the things it has flowed into being, or it transcends the self it has flowed into being.
>
> One final step is needed before Eriugena can complete his exploration of the metaphor of overflowing. This final step was foreshadowed by the alumnus's questions cited above: "But when I hear or say that the divine good created all from nothing, I do not understand what is signified by that name, 'nothing,' whether the privation of all essence or substance or accident, or the excellence of the divine beyond-essence." All understandings of nothing as privation—be they based upon temporal, spatial, or material paradigms—have been discredited. The alternative, hinted at by the alumnus in his mention of the "beyond-being," is the nonsubstantialist view of deity.[32]

The appropriation of novel cross-domain mappings reveals that conventional (kataphatic) readings of the divine are optional and overemphasize certain characteristics (e.g. the temporal priority of the deity in *creatio ex nihilo*). In the metaphor of overflow, Pseudo-Dionysius and Eriugena use the source domain of how liquids flow to structure the highly abstract concept of divine emanation (as that concept is understood in Neoplatonic philosophy). The insight of apophatic discourse, as well as of contemporary metaphor theory, is that how a person understands these abstract conceptual domains is optional. To view any conceptual mapping as necessary or essential is at best an exaggeration, and at worst an important mistake.

As for Sells' treatment of the mystical writings of Porete, Lakoff and Johnson's theory would provide helpful tools. Porete's guiding metaphor of mystical-union-as-erotic-relationship matches up well with Lakoff and Johnson's theory of cross-domain mapping. In this case, the relatively basic conceptual domain of erotic relationships is used to structure the relatively abstract conceptual domain of mystical union. Moreover, this metaphorical engagement with the divine reveals the contingency of and the problems with traditional reified conceptions of will, desire, self, subject and object, and God. The familiar mysteriousness of the lover is mapped onto the distant mysteriousness of the deity.

Conclusion

Where Lakoff and Johnson's theory of cross-domain conceptual mapping goes further than Sells' theory of mystical language is in terms of the continual reemergence of everyday factual discourse. For Lakoff and Johnson, reason is built up out of many cross-domain mappings of concepts or neural activation patterns. Sells writes of how paradoxical expressions or metaphors may destabilize a discourse (opening it up for an apophatic meaning event).[33]

However, the word "destabilize" suggests a cross-domain mapping itself—one in which the relatively basic conceptual domain of stability (perhaps of architecture) is mapped onto the relatively abstract domain of discourse. Sells' theory depends crucially on not reifying the object of mystical contemplation. He does not wish to reinterpret apophatic language as anything other than being apophatic. However, insofar as metaphors project a structure upon the target domain, the other will be reified in mystical discourses that use metaphorical mapping. Take, for example, the Dionysian expression that divinity is beyond being. This suggests a way of thinking about divinity that implies both a spatial orientation (upon which all referents are fixed, as if on a grid) and a sense of relative distance. While such a manner of thinking of divinity may function apophatically to the extent that it reveals reified aspects of kataphatic descriptions of divinity, this Dionysian expression also projects its own kataphatic meaning (namely, a certain spatial orientation). This is clearly revealed in Lakoff and Johnson's metaphor theory. Awareness of this kataphatic "residue" or remainder in apophatic discourse is consistent with Sells' theory (insofar as Sells understands his theory to have schematic or provisional status). By and large, I agree with Sells' findings. Despite a less than perfectly rigorous apophatic sensibility, his characterization of mystical language is illuminating. However, Lakoff and Johnson's theory of metaphor reveals that even Sells' characterizations are contingent and optional (despite their utility).

That said, there is nothing in Lakoff and Johnson's theory of cross-domain conceptual mapping that so much as hints at the semantic fissures in kataphatic discourse that apophasis creates. Certainly, Lakoff and Johnson are aware of the rich diversity of metaphorical mappings available across cultures. However, this dynamic of mystical language is overlooked in their theory. Moreover, I believe that a greater appreciation for religious symbolism and metaphor would give Lakoff and Johnson a better appreciation of what is at stake in differences among cultures, with respect to their paradigmatic conceptual mappings. While these are not problems for Lakoff and Johnson's account, I believe it is an oversight that these instances of conceptual mapping have been neglected.

In this essay, I have explored some implications an appreciation of Lakoff and Johnson's metaphor theory might have for Sells' theory of apophatic discourse. I believe that, for the most part, Sells would receive the greater benefit from putting the two theories into dialogue. Out of my own intellectual concerns, I would like to see Lakoff and Johnson explore the use of metaphor in mystical discourses. Dialogue with theories of mystical language might not advance Lakoff and Johnson's cognitive work on metaphor, however an awareness of cross-domain conceptual mappings in mystical discourses would provide an interesting application for the theory. Moreover, insofar as the new theory of cross-domain mappings is framed in terms of neural activation patterns, one can imagine entailments of Lakoff's theory having to do with cognitive analyses of mystical experiences. If Sells' theory is right, and if mystical "meaning events"[35] can be identified, and if these can be represented in terms of activation patterns across neural networks, then mystical events may be studied with the resources of the cognitive sciences. I find this a truly exciting possibility.

Works cited:

Hawkins, Peter, and Anne Howland Schotter, eds. *Ineffability: Naming the Unnamable from Dante to Beckett*. New York: AMS Press, 1984.

Lakoff, George. "The Contemporary Theory of Metaphor." In *Metaphor and Thought*, 2nd ed., ed. by Andrew Ortony, 202-51. New York: Cambridge University Press, 1993.

_____, and Mark Johnson. *Philosophy in the Flesh: The Embodied Mind and Its Challenge to Western Thought*. New York: Basic Books, 1999.

_____, and Mark Johnson. *Metaphors We Live By*. Chicago: University of Chicago Press, 1980.

Sells, Michael A. *Mystical Languages of Unsaying*. Chicago: University of Chicago Press, 1994.

Endnotes:

1. Unfortunately, Sells leaves this notion underdeveloped. Admittedly, his theory is schematic, so it need not be comprehensive. However, if this theory is to be filled out, then some account of performance will be necessary.

2. Sells, p. 9.

3. Ibid.

4. Ibid., p. 209.

5. Ibid., p. 215.

6. Ibid., p. 207.

7. Ibid.

8. Ibid.

9. Ibid., p. 37.

10. Ibid., p. 35.

11. Ibid., p. 55.

12. Ibid., p. 35.

13. Ibid.

14. Hawkins and Schotter, p. 1.

15. Sells, p. 36.

16. Ibid., p. 40.

17. Sells' book works well both as a philosophy of religion text as well as an historical text. In his treatment of Porete, he includes her tragic life story along side his account of her apophatic writing. The reader gets a sense of the vitality her work must have had for her. Observing a tragic irony of history, Sells writes, "it was discovered that a classic of Christian piety, which had even been published in 1911 by the Downside Benedictines in a modern English translation with the formal Church approvals of nihil obstat and imprimatur, was identical with the infamous work of the condemned heretic Marguerite Porete, a work burned in her presence in 1306, and burned along with her in 1310" (p. 118).

18. Ibid.

19. Ibid., p. 119.

20. Ibid., p. 120.

21. Ibid., pp. 120-21.

22. Ibid., p. 123.

23. Ibid., pp. 124-25.

24. Lakoff and Johnson, *Metaphors We Live By*, p. 3.

25. Lakoff and Johnson, *Philosophy in the Flesh*, pp. 57-58.

26. This convention of referring to metaphorical mappings by way of capitalizing sentential expressions of such metaphors comes from Lakoff and Johnson. The concept (or conceptual expression) on the left of the copula is the target domain, while the concept on the right of the copula ("is" and "are") is the source domain.

27. Lakoff and Johnson, op. cit., p. 61.

28. Ibid., p. 65.

29. For more on this, see Lakoff, p. 203.

30. Lakoff and Johnson, op. cit., p. 106.

31. Sells, p. 45.

32. Ibid., pp. 47-48.

33. Ibid., p. 207.

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Mythemesis: The Human Way of Knowing and Believing

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Although science, philosophy, literature, and religion each have a different way of formulating explanations, they are all telling stories of why and how. The author describes how the human propensity to seek explanation through narrative can be understood as the product of an embodied mind. He offers a hypothesis ("mythemesis") to explain the process and goes on to show that it may provide an opportunity to reduce scientific-religious conflict by transcending the dichotomy between first- and third-person modes of experience.

Being alive begs the questions: Why? How? To a greater or lesser degree each of us spends a lifetime in search of answers to these existential queries—and the myriad of lesser questions they each generate. Vast populations of people are satisfied by the answers provided in the received knowledge passed to them by their forebears and cultures. For others, the search for answers becomes a much more personal thing. Driven by a paradoxical combination of hope and skepticism, they require explanations that carry with them a certain degree of independent authenticity. Their hope lies in the very idea that explanations are possible—that the answers lie in the nature of things. Their skepticism is reserved for received knowledge itself—the unquestioning acceptance of someone else's explanation as "truth." The hopeful skeptic learns early that the personal search for answers requires humility in the face of almost certain knowledge that there are no final answers. Although it seems as if the search leads only to preliminary answers that continually generate ever-deeper questions, a sense of wonder and mystery often accompanies the searcher. As E. E. Cummings said, "Always the beautiful answer who asks a more beautiful question."[1]

But what form does our search for answers take? What constitutes an "explanation" sufficient to establish the authenticity of a point of view or an experience? In this paper, I will attempt to show that our efforts to find answers almost always take the form of narratives. The stories we tell ourselves, and the degree of resonance they have in our living experience, seem to provide the most satisfying answers to the existential questions. This feeling of "resonance" has been called the "Aha! experience," an all-encompassing sense that what one has just heard, read, seen, or thought carries an aspect of believability that stands out from the noise of normal observation and discourse. It is an embodied phenomenon that involves much more than the mental exercise of a logical proof or a statement of faith.[2] Joseph Campbell made an important observation about "resonance" and the nature of the existential search:

> People say that what we're all seeking is a meaning for life. I don't think that's what we're really seeking. I think that what we're seeking is an experience of being alive, so that our life

> experiences on the purely physical plane will have resonances within our own innermost being and reality, so that we will actually feel the rapture of being alive. [3]

Science, philosophy, literature, and religion each have a different way of formulating explanatory narratives but, at the end of the day, they are all telling stories of why and how. And they all have the capability of generating profound "Aha! experiences." Each of us carries in his or her autobiographical memory (in many forms and on many levels) interlocking stories that can be brought to awareness in consciousness where they seem to resonate with life itself. This propensity to seek explanation through narrative (i.e., "stories") may be found in all forms of intellectual pursuit and across all modes of discourse.

What could possibly be the reason for all forms of human explaining to be based on something as elementary as story-telling? Briefly stated: human mental apparatus appears to be hard-wired for narrative. The interaction of the human brain with the rest of the world is played out across time in a contextual and interactive manner. People don't just "tell" stories; they are driven by them. I have more to say below about this.

Meaning itself emerges at a certain instant during an experience when a string of mythemes formed over an interval in time "freezes" into a self-consistent whole.

I propose the term "mythemesis" to refer to this fundamental process which may lie at the core of all systems of human thought. Claude Levi-Strauss coined the term "mytheme"—the units common to many myths of diverse origin—as an analogy to what the linguist Roman Jakobson called "phonemes"—the fundamental units of sounds that make up words.[4] It would seem appropriate to carry this definition forward for use as a descriptor for a narrative-based process that seeks to explain understanding. Furthermore, the terms mytheme and mythemesis are useful when seen in contrast to currently popular reductionist terms meme and memetics which will be discussed in detail later on.

The mythemetic quest is Hegelian in nature: it seeks an explanation that bridges the epistemological gap between knowledge and belief by exploring a deeper reality that lies at the foundation of both. The sought-after deeper reality is not just another objective explanation of life and experience; it consists of nothing less than radically different definitions of both life and the living experience.

It is important to keep in mind that the dissection of a narrative entity into its component parts cannot lead to a true appreciation of its explanatory power. Just as the map is not the territory, the written or verbal narrative does not "come alive" until it passes through the brain. The "meaning" that one derives from a narrative fragment results not from using grammar, syntax, and vocabulary to manipulate symbols, but from a complex interplay of the symbols with one's own mental apparatus and unique autobiographical memory—"the organized record of the main aspects of an organism's biography."[5] The mythemesis event is both experiential and descriptive, bridging the gap between first- and third-person modes of description.

Levi-Strauss observed that myths from different cultures carry certain similarities, regardless of their origin. Moreover, myths are not only made from language—because stories must be "told"—but also they are a kind of language unto themselves.[6] Through this language, people attempt to understand the world (and their place in it) by superimposing dualistic pairings on phenomena that may, in actuality, be totally integrated. Levi-Strauss saw the basis of the propensity to dichotomize experience in attempting to understand it as a natural property of the brain itself. The brain functions in a binary sort of way. The questions people ask of the environment are usually in the nature of comparisons; they tend to divide things in half and then to divide the halves in half, etc. Levi-Strauss referred to the component parts that result from this dialectical process of fragmenting the world as "mythemes." The telling and retelling of myths is a process of putting mythemes back together in ever-changing but ever-related combinations and forms.[7]

It is important to realize that Levi-Strauss does not see the world as binary in nature, but rather our mental perception of it. This ingrained tendency mentally to fragment the "external" world not only impacts our understanding of the world but, more importantly, impacts our definition of "understanding" itself. By informing the general Cartesian notion of separation of mind and matter with its principle epistemological method, the natural human propensity to dichotomize gave rise to reductionism. Most of the great advances in science since the enlightenment resulted from the reductive analysis of matter in terms of the nature and relation of its constituent parts. However, reductionism has been unable to explain first-person experience to a satisfactory level.

There is a growing consensus among cognitive scientists and philosophers of mind that the definition of "understanding" must be expanded or changed to accommodate phenomenological experience. It is not a Kuhnian scientific "paradigm shift" that seems to be in order, but rather an epistemological one.[8] It is not a new way of looking at things; it is a new way of looking, one that must somehow incorporate a redefinition of the relationship of the observer (self) and the observed (things), such that first-person and third-person views of reality become mutually comprehensible.

Mythemesis: a new hypothesis of understanding

Levi-Strauss's concept of the mytheme offers a good starting point toward the development of a non-reductionist approach to the understanding of living experience and the processes that give rise to it. Three sequential steps lead to meaning through the narrative process I have called "mythemesis."

1. Fuzzy representation

Mythemes are the units of intentionality (all thoughts are about something). They are the names and labels given to the pieces into which experience is perceived to be divided. Each mytheme carries with it a wide variety of different but occasionally related definitions. Which specific definition is operant at any given time is determined by the context in which the mytheme is embedded. It is important to note that the "fuzziness" of mythemetic definitions is the primary source of their utility.

2. Self-organization

A necessary prelude to meaningful experiential events is the non-conscious self-assembling of mythemes into linear groupings (strings) over time. These assemblings just "happen" in our brain/bodies as a natural (evolutionary) result of our being-in-the-world. They occur rapidly and in parallel. Most of them do not reach consciousness. These groupings correspond to what Dennett has called "Multiple Drafts" in his model of consciousness:

> (All) varieties of perception–indeed, all varieties of thought or mental activity–are accomplished in the brain by parallel multitrack processes of interpretation and elaboration of sensory inputs. Information entering the nervous system is under continuous "editorial control."[9]

3. Emergence

Meaning itself emerges at a certain instant during an experience when a string of mythemes formed over an interval in time "freezes" into a self-consistent whole. It is only at this instant that specific definitions of each and every mytheme in the string are simultaneously selected from the wide variety of potential definitions each could have. The specific final definition of each mytheme in the experiential interval is tied by mutual consistency to the specific final definition of every other mytheme in the string. The sudden and virtually simultaneous establishment of contextually consistent definitions across the population of mythemes in the experiential interval creates a resonance effect that drives the process to consciousness to become what we accept as the overall meaning of the experience.[10]

Mythemesis differs from reductionist approaches in that it postulates that meaning does not result from an analysis of precisely defined parts and their interactions. On the contrary, meaning emerges as a self-consistent combination of parts in which the definition of each part is not precisely determined until it takes its place in the resonant context of the selected combination. Reductionism is a bottom-up, analytical process while mythemesis is a top-down combinatorial one.

Here is a simple example of how context and the interplay of mythemes can lead to three widely different "meanings" (mythemes, the "fuzzy" variables, are in italics):

> The lumberjack...*honed...on the beam...sailing...*

Meaning 1: The lumberjack let his freshly honed ax fall on the beam and chips went sailing.
Meaning 2: The lumberjack, having honed his skills, felt on the beam and went sailing.
Meaning 3: The lumberjack honed in on the beam and located the sailing vessel.

Cognition

The Oxford Companion to the Mind defines cognition as "the use or handling of knowledge." It also suggests that the word "cognition" is probably related to "gnomon" —the shadow-casting rod of the sundial, which measures the heavens from shadows.[11] Thus, the concept of the brain/mind as an organ of representation is built into the very root of the term that scientists have applied to the process used to understand our world. Classical cognitivists (especially computational cognitivists) stress the necessity of intentionality and hypothesize that cognition consists of symbolic representations in the brain.[12] These representations subsequently drive human actions in an externally independent world and, therefore, one needs only study these symbols and their manipulation to understand thought.

There is another way of looking at the relation of culture, communication and context that focuses on process as well as content, and that does not depend on classical views of symbolic representation. Humberto Maturana characterizes "cognition" as follows:

> ...an effective action, an action that will enable a living being to continue its existence in a definite environment as it brings forth its world. Nothing more, nothing less.[13]

The organism is, in fact, embedded in its world. Even the use of the word "environment" implies too great a separation between a given organism and the rest of existence. This point of view considers language not to be merely the exchange of symbolic and representational "information" between two cognitive entities, but rather consensual interaction (coupling) between the organisms.

In *The Embodied Mind*, the neuroscientist Francisco Varela and his colleagues reemphasize the conviction that cognition is not the representation of an independently existing world by a pregiven mind. It is, rather, "the enactment of a world and a mind on the basis of a history of the variety of actions that a being in the world performs." Varela proposes the term "enactive" to refer such a view.[14]

In a nutshell, the enactive approach consists of two points: (1) perception consists in perceptually guided action; and (2) cognitive structures emerge from the recurrent sensorimotor patterns that enable action to be perceptually guided.[15] In other words, perception is not based on the organism's ability to form and manipulate symbolic representations of a independent external world, but rather on the nature of its sensorimotor structure. The enactive approach seeks to explain perception by determining the interrelationships between the sensory and motor systems. These relationships give rise to actions that allow the organism to make its way (be "perceptually guided") in a world that is dependent on its own perceptual abilities.

> In such an approach, then, perception is not simply embedded within and constrained by the surrounding world; it also contributes to the enactment of this surrounding world.... [We] must see the organism and environment as bound together in reciprocal specification and selection.[16]

This view of the organism as an embedded perceiver-actor in a perception-dependent world is decidedly first-person in nature. Third-person (reductionist/objectivist) explanations are unable to capture the essence of experience because, of necessity, they separate the experiencer from the experience. This has been called the "hard problem" in consciousness studies.[17]

The concept of cognition as an embodied phenomenon supports the mythemesis hypothesis of human understanding. The promotion to consciousness of a self-consistent string of mythemes as an explanation could be considered to be a form of "enaction." Understanding is, in effect, perceptually guided by the possibilities for action in the world. It is a blending of first and third person in which actions in the mind and in the world are coupled. In actuality, from an information perspective, there is no hard boundary between the brain and the rest of the world. There is no consciousness without the world —even memory is the result of previous mind-world couplings. There is no world without consciousness. There is no understanding without an enactive dynamic coupling between the two—a coupling so complete as to make them a unity.

Genes and memes

Darwin's original explication of natural selection had three principle components: variation, selection, and heredity. In his widely-read book *The Selfish Gene*, Richard Dawkins presented his view that biological evolution is best understood as competition among genes.[18] Essentially he applied Darwin's model for natural selection directly to genes themselves—saying that they are selfish in the sense that their main "purpose" is to get themselves replicated and passed to the next generation. Anytime a replicator makes imperfect copies of itself, only some of which survive, evolution is inevitable. In brief, Dawkins feels that the purpose of organisms is to function as vehicles (sometimes referred to as "interactors") for the replication and survival of genes. The selfish gene model has as many detractors[19] as proponents,[20] but the important point for this discussion is that Dawkins has generalized his hypothesis to include forms of evolution other than that of living organisms. Most interesting to us is the application of the concept of the "differential survival of competing replicators" to the evolution of mind and culture. At the end of *The Selfish Gene*, Dawkins proposed the appearance of a new replicator —a unit of imitation—which he called the "meme."

> We need a name for the new replicator, a noun that conveys the idea of a unit of cultural transmission, or a unit of imitation. "Mimeme" comes from a suitable Greek root, but I want a monosyllable that sounds a bit like "gene". I hope my classical friends will forgive me if I abbreviate mimeme to meme.[21]

Dawkins proposes that, like genes, memes are replicators passing from the brain of one person to that of another, sometimes stored, in the interim, in books, films, audio media, or the like. A meme is any element of culture, such as words, songs, rituals, beliefs—virtually anything that can be transmitted through symbols, images, behaviors, and the like. Robert Wright recently observed, "The 'meme' meme has manipulated a lot of brains since Dawkins unleashed it." In other words, it has attained such widespread recognition that it is itself an example of a successful "memetic" replication.[22]

Daniel Dennett is another major supporter of memetics:

> The primary difference between our species and all the others is our reliance on cultural transmission of information, and hence on cultural evolution. The unit of cultural evolution, Dawkins' meme, has a powerful and under-appreciated role to play in our analysis of the human sphere. [23]

Dennett says that these new replicators, memes, are roughly complex ideas that are assembled in distinct memorable units. Some examples he gives are the following:

> arch
> wheel
> wearing clothes
> vendetta
> right triangle
> alphabet
> calculus
> chess
> perspective drawing
> evolution by natural selection
> impressionism
> "Greensleeves"
> deconstructionism

Dennett points out that it is difficult to formulate a science of memes comparable to a science of organic evolution due to the fact that the "very creativity and activity of human minds as temporary homes for memes seem to guarantee that lines of decent are hopelessly muddled." [24] He (among others) is still convinced, however, that a case can be made for a memetic theory of cultural evolution analogous to the genetic theory of organic evolution. In fact, in Dennett's opinion, memes are just as selfish as genes:

> The haven all memes depend on reaching is the human mind, but a human mind is itself an artifact created when memes restructure a human brain in order to make it a better habitat for memes.[25]

The "second replicator" or meme theory is consistent with the prevailing cognitive perspective that permeates much of the current literature in mind science. This prevailing paradigm sees the mind as processor and the individual as a transmitter of symbols. Although the hard-core functionalist idea of the brain as a computer and the mind as "software" has fallen out of vogue, there is still a tendency among cognitivists to focus on the brain's inputs and outputs as if they were somehow causes instead of the effects.

Mythemes vs memes

One can see the power of mythemesis by contrasting how it could be used to deal with a number of issues that have been addressed by adherents of the memetics approach. Several books have appeared recently that are devoted entirely to the subject of memes.[26] However, Blackmore's *The Meme Machine* is the most ambitious in that it proposes that a "science of memetics" can "explain," among other equally significant phenomena, the large size of the human brain, the origins of language, sex, altruism, and the appearance of religions.[27] I hope to show, by close examination of Blackmore's treatment of these subjects, that an epistemology of mythemesis, based on emergent properties of whole systems yields far more intellectually satisfying explanations than a reductive science of memetics based on the transmission of informational "atomic" entities from brain to brain.

Blackmore's science of memetics is based on the concept of universal Darwinism. Any process that requires three main features—variation, selection, and retention (or heredity)—can be considered to be "Darwinian." As genes provide the instructions for making proteins, so memes provide the instructions for behavior. As the competition among genes drives the evolution of the biological world, she argues, so the competition among memes (stored in brains or elsewhere) drives the evolution of the mind: "...they are the very stuff of our minds. Our memes is who we are." [28]

Mythemesis provides an alternate explanation to memetics as the basis of mind and behavior. The narrative (the story in the mind) drives behavior using words and phrases. These units of narrative in the mind do not have discrete and well-defined meanings (i.e., as memes supposedly do). On the contrary, they are very "fuzzy" in their definition and symbolic content. They are capable of many meanings. The narrative "comes together"—the overall meaning emerges in a resonant fashion—only at the instant when the specific meanings (symbolic contents) of all words and phrases in the mythemetic experience are simultaneously selected from a wide variety of potential meanings. Memes don't change minds. Minds change mythemes. By focusing on the symbolic units of language and sensory perception, instead of on the embodied and enactive organism undergoing the actual experience, the memeticists miss the most important and fascinating process occurring in the human brain: the continuous combinatorial synthesis of meaning from a substrate of myriad possibilities.

Blackmore carries the memetics argument further by postulating that memes are not only responsible for the regulation of behavior but actually are the principle cause of the evolution of the large brain in humans. Her argument goes as follows:

> The turning point in our evolutionary development was when we began to imitate each other. From this point on a second replicator, the meme, came into play. Memes changed the environment in which genes were selected, and the direction of change was determined by the outcome of memetic selection. So the selection pressures, which produced the massive increase in brain size, were initiated and driven by memes.[29]

Imitation is postulated to be the basis of social learning. Since natural selection would favor those who become socially adept, brain size in humans increased as more and more capacity was required for the more and more complex memes being generated in the competitive process of social evolution. In a few million years, not only have the memes changed out of all recognition but the genes have been forced into creating brains capable of spreading them.[30]

Three types of imitative selection are suggested as the basis for this meme-driven evolutionary increase in the size of the brain:

1. Selection for imitation. Those skilled at it will be better suited for survival.

2. Selection for imitating the imitators. Those who are good at copying the best copiers will not only be more successful themselves, but will pass on the imitation-related genes to their progeny

3. Selection for mating with the imitators. Those who choose good imitators as mates will fare better than those who don't and will assist in passing on the appropriate genes. Sexual selection can be thought of as a variant of this type. People who are good at imitating the useful social memes of the time would be more attractive to those of the opposite sex, memetic agility being a sort of "peacock's tail" of human beings.

But is the reification of words and other learned snippets of behavior into memes necessary to explain the massive size of the human brain? Not if the focus is shifted away from the symbolic entities that are manipulated in human thought and discourse toward the embodied mind itself. The human brain functions primarily in a relational way. Human beings are embedded in their worlds. The old assumption that they are independent entities functioning in an "environment" is being rapidly superceded by the idea that they are inextricably tied to the world and continuously interacting with it.[31] Therefore the milieu undergoing change and selection must be expanded beyond isolated brains and symbols to include the organism-world interaction. The most effective organism-world interactions will be favored by selection forces for survival. The human beings who are most successful at interacting with their world will be preferentially selected for. As the human-world interactions become more and more social and concept-driven, those humans with the brain capacity to combinatorially formulate the most effective mythemes will have a decided advantage. Brain capacity would grow as the result of the evolution of more neuronal groups of increasing complexity, since such capacity and complexity would be required to accommodate the increasing sophistication of the mythemesis process.

The subsequent rift between science and religion was compounded by the exclusion of first-person "knowledge" from the decidedly third-person methodology of scientific investigation.

There are three types of mythemetic selection that may be postulated as analogies to the "imitative" selection types suggested by Blackmore:

1. Selection for mythemesis itself. The large volume of the human brain compared to other primates is due almost entirely to the expansion of the cortex, which contains all the regions of the brain responsible for higher cognitive abilities. The ability to carry in memory a large number of "fuzzy" descriptors and, more importantly, the ability to bring them into coherence upon the self-assembly of the mytheme are important survival skills. These skills require large numbers of neurons in certain cortical areas of the brain, along with a plethora of connections between them.

2. Selection for learning mythemesis. It has been shown that learning, memory and other cognitive abilities are functions of the strength and number of synapses between neurons.[32] An individual with a marginally higher capacity for generating mythemetic experiences (i.e., possessing more effective neuronal configurations and connections) will have a marginally better chance of survival and, thus, of passing his/her genes on to the next generation.

3. Selection for mating with successful practitioners of mythemesis. An individual who consistently exhibits the ability to make sense of the world through an extraordinary ability to formulate mythemetic "stories" useful for survival would certainly be more attractive as a mate than one whose stories were simplistic and useless. Thus, from a mythemesis point of view, the "peacock's tail" of human beings is the exhibition of creativity and understanding, not just being a good copycat.

Blackmore also contends that memes are responsible for the evolution of language.

> Once imitation evolved, something like two and a half million years ago, a second replicator, the meme was born. As people began to copy each other the highest-quality memes did the best – that is those with high fidelity, fecundity, and longevity. A spoken grammatical language resulted from the success of copyable sounds that were high in all three. The early speakers of this language not only copied the best speakers in their society but also mated with them, creating natural selection pressures on the genes to produce brains that were better and better at spreading the new memes. In this way the memes and genes coevolved to produce just one species with the extraordinary properties of a large brain and language. The only essential step to starting this process was the beginning of imitation. The general principles of evolution are enough to account for the rest.[33]

She builds her argument for meme-driven evolution of language on her arguments for meme-driven regulation of behavior and brain growth. An alternative explanation—that language is an emergent phenomenon, driven by the human need for understanding through narrative in the context of the organism-world interaction—may be built on the mythemetic arguments for these two phenomena that were offered above. If the organism-world interaction is viewed as the prime substrate upon which evolutionary forces operate, then the brain may be seen as an interface between the world and the behaving organism. Once the brain developed to a point where it had sufficient memory and comparative facility to remember a past and visualize a future, it would then have acquired the capacities to conceptualize the human-world interaction mythemetically, as stories. Language may have developed to accelerate the reinforcement of stable human-world interactions via

There are strong reasons to believe that, even now, mythemetic self-organization and emergence is proceeding along the next tier up on the complexity ladder. It probably includes us, our mental machinations, and our behavior as component "fuzzy variables."

mythemetic representation. The advent of "copyable sounds" was certainly a necessary precursor to language, but their emergence did not drive the development of language. Rather it provided the raw material for the fuzzy symbolism required by an organism that had developed an extraordinary survival mechanism—the ability to "couple" with its world through the felt resonance of the narrative.

The selfishness of genes reconsidered

It is interesting to note that the memeticists, in defining the meme as a "second replicator" (the gene being the first replicator), have made use of a narrative tool: analogy. What if one were to take the mythemesis hypothesis and apply it by analogy (in the opposite direction), to evolution? Perhaps evolution itself is a complex, self-generative process that is driven primarily by optimization of the contextual resonance of the continuously emerging "types" of living beings that make up a given (complex) ecological system. In other words, species become the genetic analogue to mythemes. Genes would retain their role as the carriers of the recipe for construction and maintenance of the individuals of a given species, but they would be far less important as determinants of the state of the ecological system. With the exception of clones and identical twins, the genetic make-up of an individual of a species differs from that of every other member of the species. Also, the overall composition of the gene pool of a species at any point in time differs from its composition at any other point in time. This diversity (analogous to the "fuzziness" of mythemes) in the individual and species genotypes is enhanced by mutation and by recombination (in species that reproduce sexually). This diversity of individual genotypes provides the necessary raw material for the ecological system as a whole to draw from. Selection, in this view of life, acquires a whole new meaning. The old Darwinian "survival" principle is not applicable because, from a system-wide perspective, the local behavior of individual members of individual species making up the ecological whole is only important in the context of the behavior of every other species in the system. Moreover this context is continuously changing as new generations of all the species replace the old. When evolution is viewed as a combinatorial phenomenon, and species as highly interactive components in a dynamic complex system, selection must be redefined as an emergent system-wide property. Species do not individually "adapt" to "environments"; rather their behavior continuously changes (reflected in continuous changes in the gene pools) in the context of the resonant interaction of all the species in the ecosystem. If, ultimately, a species becomes extinct, it is not because it is ill adapted but because it, in effect, has become less meaningful in the context of the emerging relationships of the evolving ecological system.

The genetic makeup of a species, of course, sets the boundaries within which behavioral change must be contained. But the combinatorial possibilities that exist in a diverse ecosystem, even with a relatively narrow range of genotypic diversity within each species are countless. Nothing is "selfish" in this approach, especially genes. The variability ("fuzziness") in each genotype, in fact, makes possible the optimization (resonance) and survival of the overall ecosystem. Stephen Jay Gould and other critics of the selfish gene argument have expressed similar views.[34]

Metamythemesis: The emergence of a "higher power"

The natural philosophers of the early European Renaissance sought understanding from two sources: the Holy Scriptures and the "book of nature." They believed that God began to tell the story of existence in what became the canonical books of the Bible, and then continued to reveal divine truth through creation in the world. This dual revelatory narrative provided a framework for the compatible coexistence of belief and empirically derived knowledge. The subsequent rift between science and religion resulted from an ever-increasing number of perceived inconsistencies between the scriptural narrative and empirical observation of the workings of the universe. This rift was compounded by the exclusion of first-person "knowledge" from the decidedly third-person methodology of scientific investigation. Could mythemesis provide a new narrative form capable of bridging the gap between science and religion?

The French philosopher Paul Ricouer traces the power of the religious experience to the language of religion. He says that a religious faith may be identified through its language, that it consists of a kind of discourse. It has something special to say that is not said by other types of discourse—ordinary, scientific, poetic. Most significantly, religious language implies a type of philosophy because it is a discourse that claims to express truth.

> A hermeneutic philosophy…will try to get as close as possible to the most originary expressions of a community of faith, to those expressions through which the members of the community have interpreted their experience for the sake of themselves or for others' sake.[35]

In other words, what is important to determine is not some absolute meaning based on a set of assumptions but rather to allow the meaning (as it is experienced by the audience members themselves) to emerge from the discourse itself. Readers or listeners finds themselves in what Ricouer calls the world of the text, in which, unlike normal discourse, the primary reference to things or persons in the "real" world is subordinated to a sense of meaning that resonates with the reader.

Reader find themselves or what they want for themselves from a certain "understanding" of the text. So, in an analogous fashion, just as meaning emerges from the context of words in a sentence and as species emerge from the context of the components of a biosphere, belief emerges from the context of the sacred stories. Ricouer says that being-in-the-world unfolds "in front of the text." Building on Heidegger's suggestion of the meaning of *Verstehen* (understanding) and *Befindlichkeit* (state of mind), he suggests that the moment of understanding (the "Aha! experience," or epiphany) comes when someone responds dialectically to being in a situation in which one's "own-most" possibilities are projected in situations in which we find ourselves.[36]

If we assume that evolving, self-organizing systems at higher levels of complexity—building on life and thought—are truly passing beyond our ability to grasp them, then a new story is being told. It is a story being written by the universe, a third discourse beyond theology and science that transcends both.

It seems that mythemesis underlies faith itself. Faith corresponds to finding oneself and discovering one's unique (ownmost) possibilities in the context of a sacred story.

> [F]aith never appears as an immediate experience but always as mediated by a certain language that articulates it. For my part I should link the concept of faith to that of self-understanding in the face of the text. Faith is the attitude of one who accepts being interpreted at the same time that he or she interprets the word of the text. [37]

All of this leads to the conclusion that metaphor is not just a literary form that lends itself to interesting comparisons regarding mind, life, and faith. It is actually the epistemological linchpin that underlies the structures of and the relationships between these three basic realms of human existence. In all of these spheres of experience, we have arrived in the middle of the story. Classical concepts of causation and atomistic reductionism do not provide sufficient understanding for a person to function, with confidence, in the dynamic complexity of day-to-day existence. Each person must seek understanding in the interplay of relationship and history. To reach ongoing understanding, particularly at the pragmatic level, contextual stories must be continually formulated, from which emerge—usually metaphorically—the resonant combinations of mythemes that give meaning to experience.

The level of organization at which we find ourselves to have emerged in the universe need not—indeed, probably cannot—be the final tier. We are only a chapter in a story of life in a text that the universe continues to write in time. The process of self-organization, even as it is currently only partially understood, is known to be relentlessly forward-biased and creatively combinatorial. There are strong reasons to believe that, even now, mythemetic self-organization and emergence is proceeding along the next tier up on the complexity ladder. It probably includes us, our mental machinations, and our behavior as component "fuzzy variables." We have little or no control over this "meta-mythemesis" process and may not even have the ability to fully conceptualize it. However, we need only look around us to see indications that higher level self-assembly is underway. Genetic engineering, robotics, artificial intelligence, the internet, and the globalization of the economy are only a few of the dynamic, complex interactive systems that are generating new combinatorial possibilities. Our present confusion about if, when, and how we should attempt to regulate these systems underscores our inability effectively to understand a higher level of emerging self-organization that we neither designed nor predicted.

Most likely, new interacting systems of "metamythemes" with complexity beyond our understanding and with organizational structures that combine information, flowing electrons, organic systems (including human brains), and unique energy exchange processes, already exist in ways that cannot be grasped by creatures on a lower plane of existence. Such interacting systems are probably transparent to us because we are merely subsystems in the emergent superorganism. Molecules have emerged from the interactions of atoms, cellular life has emerged from the interaction of molecules, and consciousness has emerged from the interaction of cells with each other and the rest of the world. What happens now?

The only prediction that can be safely made is that when the future becomes the present, it will not have been predicted. This will hold true, whether one is talking about the economy, the environment or geopolitics. The complexity of the relationships in each of these areas is usually cited as the reason for our inability to foresee economic downturns, environmental catastrophes, or the outbreak of hostilities due to ethnic and cultural conflicts. But what we have learned about the nature of complex interactive systems, i.e., that they have a tendency toward combinatorial self-organization, should lead us to take the analysis further. The rise of unpredictable and (to us) catastrophic events in the world may not be due primarily to complexity and deterioration of order in worldwide economic, ecological, nor social mechanisms. Paradoxically, they may be byproducts of a process analogous to mythemesis—an emerging higher level of order arising from the genesis of new superorganisms whose functioning through time leave such occurrences in their wakes. If this is true, Yeats's poem, "The Second Coming," takes on an ominous new meaning.

> Turning and turning on the widening gyre,
> The falcon cannot bear the falconer;
> Things fall apart; the center cannot hold;
> Mere anarchy is loosed upon the world,
> The blood-dimmed tide is loosed, and
> everywhere
> The ceremony of innocence is drowned;
> The best lack all conviction, while the
> worst
> Are full of passionate intensity.
>
> Surely some revelation is at hand;
> Surely the Second Coming is at hand.
> The Second Coming! Hardly are those
> words out

When a vast image out of *Spiritus Mundi*
Troubles my sight: Somewhere in the
sands of the desert
A shape with a lion body and the head
of a man,
A gaze blank and pitiless as the sun,
Is moving its slow thighs, while all
about it
Reel shadows of the indignant desert birds.
The darkness drops again, but now I
know
That twenty centuries of stony sleep
Were vexed to nightmare by a rocking
cradle,
And what rough beast, its hour come
round at last,
Slouches toward Bethlehem to be
born?[38]

What rough beast, indeed! How can we begin to approach any degree of understanding of the "vast image out of *Spiritus Mundi*?" If we assume that evolving, self-organizing systems at higher levels of complexity—building on life and thought—are truly passing beyond our ability to grasp them (at least in a reductionist fashion), then a new story is being told. It is a story being written by the universe, a third discourse beyond theology and science that transcends both. It is the story of an emerging "higher power." Although we are not the authors of the story, we are the prime source of its component mythemes. The beast will be autonomous but its nature will be determined in large part by what we supply to the combinatorial processes from which it is emerging. The character of the beast will reflect our character and that of our social, economic and political processes. The quality of our lives will not be determined directly by our desires but rather by our actions, and by how those actions resonate in the living narrative of the emerging "higher power." We will reap what we sow.[39]

Works cited:

Blackmore, Susan. *The Meme Machine.* New York: Oxford University Press, 1999.

Brodie, Richard. *Virus of the Mind: The New Science of the Meme.* Seattle: Integral Press, 1996.

Cummings, E. E. *Complete Poems 1913-1962.* New York: Harcourt Brace Jovanovich, 1972.

Campbell, Joseph. *The Power of Myth.* New York: Doubleday, 1988.

Chalmers, David J. *The Conscious Mind: In Search of a Fundamental Theory.* New York: Oxford University Press, 1996.

Churchland, Paul M. *The Engine of Reason, The Seat of the Soul.* Cambridge: The MIT Press, 1995.

Crick, Francis. *The Astonishing Hypothesis.* New York: Charles Scribner's Sons, 1994.

Damasio, Antonio. *Descartes' Error.* New York: G. P. Putnam's Sons, 1994.

_____. *The Feeling of What Happens.* New York: Harcourt Brace & Company, 1999.

Dawkins, Richard. *The Selfish Gene.* New York: Oxford University Press, 1976.

Deacon, Terrence W. *The Symbolic Species: The Co-evolution of Language and the Brain.* New York: W. W. Norton & Company, 1997.

Dennett, Daniel C. *Consciousness Explained.* Boston: Little, Brown, 1991.

_____. *Darwin's Dangerous Idea: Evolution and the Meanings of Life.* New York: Simon & Schuster, 1995.

Edelman, Gerald M. *Bright Air, Brilliant Fire: On the Matter of the Mind.* New York: Harper Collins, 1992.

Eldridge, Niles. *Reinventing Darwin: The Great Debate at the High Table of Evolutionary Theory.* New York: John Wiley & Sons, Inc., 1995.

Gould, Stephen Jay. *Wonderful Life: The Burgess Shale and the Nature of History.* New York: W. W. Norton, 1989.

Gregory, Richard L., ed. *The Oxford Companion to the Mind.* New York: Oxford University Press, 1987.

Kuhn, Thomas S. *The Structure of Scientific Revolutions.* Chicago: University of Chicago Press, 1962.

Lakoff, George. *Women, Fire, and Dangerous Things.* Chicago: University of Chicago Press, 1987.

Levi-Straus, Claude. *Myth and Meaning.* New York: Schocken Books, 1995.

Lynch, Aaron. *Thought Contagion: How Belief Spreads through Society.* New York: Basic Books, 1996.

Margolis, Eric, and Stephen Laurence, eds. *Concepts: Core Readings.* Cambridge: MIT Press, 1999.

Maturana, Humberto R., and Francisco J. Varela. *The Tree of Knowledge: The Biological Roots of Human Understanding.* Boston: New Science Library, 1987.

Minskey, Marvin. *The Society of Mind.* New York: Simon and Schuster, 1986.

Ricoeur, Paul. *Figuring the Sacred: Religion, Narrative, and Imagination.* Minneapolis: Fortress Press, 1995.

Seager, William. *Theories of Consciousness.* New York: Routledge, 1999.

Varela, Francisco J., Evan Thompson and Eleanor Rosch. *The Embodied Mind.* Cambridge: The MIT Press, 1996.

Wright, Robert. "You Can Copy Off Me." *New York Times Book Review* (25 April 1999): 12.

Yeats, William Butler. "The Second Coming." In *The Rag and Bone Shop of the Heart: A Poetry Anthology*, ed. by Robert Bly, 216. New York: Harper, 1992.

Endnotes:

1. Cummings, p. 462.

2. For an in-depth discussion of the concept of "embodiment," see Varela, Thompson and Rosch.

3. Campbell, p. 5.

4. Levi-Strauss.

5. Damasio, *The Feeling of What Happens*, p. 17. See also Damasio, *Descartes' Error*, ch. 5 and 10.

6. Levi-Strauss.

7. Ibid., p. 12.

8. Kuhn.

9. Dennett, *Consciousness Explained*, p. 111.

10. Recent investigations into the neural correlates of consciousness have shown that these "resonance effects" might actually be identical to consciousness. For example, Crick and Koch have postulated that synchronized firings of neurons in the visual cortex might be the "neural correlates of visual awareness" (Crick, p. 248).

11. Gregory, p. 149.

12. Churchland; Margolis and Laurence; Minskey; Lakoff; Seager.

13. Maturana and Varela, p. 29; emphasis in original.

14. Varela, Thompson and Rosch, p. 9

15. Ibid., p. 173.

16. Ibid., p. 174.

17. Chalmers, p. xii.

18. Dawkins.

19. See, for example, Gould, and Eldridge.

20. Dennett and Deacon are strong supporters.

21. Dawkins, p. 192.

22. Wright.

23. Dennett, *Darwin's Dangerous Idea*, p. 331.

24. Ibid., p. 355.

25. Ibid., p. 365.

26. For example, see Brodie, Lynch.

27. Blackmore.

28. Ibid., p. 22.

29. Ibid., p. 74.

30. Ibid., p. 77.

31. Varela, Thompson and Rosch.

32. Edelman.

33. Blackmore, p. 107.

34. Gould.

35. Ricouer, p. 37.

36. Ibid., p. 43.

37. Ibid., p. 46.

38. Yeats.

39. A comparison of the concepts discussed in this paper may be summarized as follows:

	Memetics Hypothesis	Mythemesis Hypothesis	"Selfish Gene" Hypothesis	Combinatorial Emergence Hypothesis
Units	Memes	Mythemes	Genes	Species
Core operational principle	Replication of memes	Self-assembly of mythemes	Replication and mutation/selection of genes	Self-assembly of species and selection of genes
Philosophical perspective	Reductionism	Emergence	Reductionism	Emergence
Nature of representation	Context-independent and precise	Context-dependent with potential for wide diversity	Context-independent and precise	Context-dependent with potential for wide diversity
Role of the individual	Vehicle	Enactive agent	Vehicle	Enactive agent
Epistemic principle	Imitation	Combinatorial creation	Imitation	Combinatorial creation

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Proposing a Model of "Hypostatic Union" for a Fruitful Science-Religion Relationship

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Karl Rahner affirmed that, methodologically, practical science should be atheistic. This cannot be truer in our time, when science is making giant progressive strides every day, solving serious problems, helping to affirm human autonomy and independence from the absolute, and consciously or unconsciously deleting from mental categories every reference to the miraculous. This situation calls for a reworking of a possible and enduring reconnection of practical science with theology, so that the methodological atheism of practical science does not become a manner of living, and so that the seeming dumbness of religion before the ever-advancing practical science does not transform itself into an intellectual unproductivity. The author proposes a hypostatic model for a return to a fruitful relationship between the two disciplines.

Historical background

For the catholic theology, Jesus Christ, the Word made flesh, who lived historically some thousands of years ago in the Middle East is God. The saying that he lived thousands of years ago in the Middle East contains in itself the truth that he lived as a man among his people. Therefore, he is for the catholic faith and theology true God and true Man. He is a specific one person in whom exist two natures, human and divine, possible through what is historically referred to as the "hypostatic union." This is a union in which the divine and human natures (*physis*) are harmoniously united in the single substance (*hypostasis*) of the divine Logos. From the earliest centuries, the Church had engaged in a theological struggle against many lines of thought and theological traditions in order to safeguard the teachings on this dual nature of Christ. In this, the Church in different councils through the centuries formulated different dogmatic definitions, which must be accepted, believed, and professed. Prominent among these councils were the Nicene, the Constantinopolitan, the Ephesian, and the Calchedonian Councils.

The Nicene Council (325 C.E.), with a reaffirmation of the divinity of Christ, condemned Arius and his disciples, who, insisting that only God the Father is ungenerated, saw Jesus Christ (the generated Son) as a creature, though of an order higher than the human. The Council of Constantinople (381 C.E.) reaffirmed the integrity of the human nature of Christ, condemned Apollinare and his followers, who identified "nature" with "person." In doing so, it became difficult for them to reconcile the cohabitation of two persons in a single individual and, as a consequence, considered the humanity of Christ as unreal. Further, in 431 C.E., the Council of Ephesus reaffirmed the perfect unity existing between these two natures in Christ. It condemned Nestorius and his students, who, in insisting on *Christotokos* (Mother of Christ) and rejecting *Theotokos* (Mother of God) as the true title of the Blessed Virgin Mary, separated in a radical manner the divine and the human natures in Christ. And finally, there was the Council of Calchedonia of 451 C.E., which condemned the christological error of monophysitism. This error was authored by Eutyches, who, teaching the opposite of the Nestorian error, affirmed that when the divine Logos assumed the human nature, it absorbed it completely in such a way that the human nature was completely annihilated. He held that before the union, there were two distinct natures, but after the union, what remained is only the divine nature. This error consists, as the name implies, in turning the dual nature of Christ into one.

The hypostatic union

Historically, the dogmatic formula popularly known as the "hypostatic union" is identified with the Council of Calchedonia. The creed issuing from that Council says:

> ...the Lord Jesus Christ, is one and the same, the same perfect in divinity, the same perfect in humanity, true God and true man, consisting of a rational soul and body, consubstantial with the Father in divinity and consubstantial with us in humanity, 'in all things like as we are, without sin' [Heb 4:15], born of the Father before all time as to his divinity, born in recent times for us and for our salvation from the Virgin Mary, Mother of God, as to his humanity.
>
> We confess one and the same Christ, the Son, the Lord, the Only-begotten, in two natures unconfused, unchangeable, undivided and inseparable. The difference of natures will never be abolished by their being united, but rather the properties of each remain unimpaired, both coming together in one person (prosopon) and substance (hypostasis), not parted or divided among two persons (prosopa), but in one and the same Only-begotten Son, the divine Word, the Lord Jesus Christ, as previously the prophets and Jesus Christ himself taught us and the Creed of the Fathers handed down to us. The above having been considered with all and every care and diligence, this Holy Ecumenical Council has defined that no one may advance any other belief or inscribe, compose, hold or teach it in any other way.[1]

Commenting on this dogmatic definition, Gerald O'Collins wrote:

> ...the second part of the confession (302) broke new ground by affirming Christ's one person ('*prosopon*' and '*hypostasis*') "in" his two natures, human and divine. It specified that "the one and the same Christ, Son, Lord, and Only Begotten" had been made known in these two natures which without detriment to their full characteristics, continue to exist "without blending or change, and without division or separation", while belonging to only one and not two "persons" (*prosopa*).[2]

Though the teachings of this council were primarily directed against Eutyches and the monophysists, it also condemned every previous christological error (Arianism, Apollinarianism, and Nestorianism), and became this way an indispensable point of reference for any catholic Christology worthy of the name. In a nutshell, the hypostatic union teaches that in the person (hypostasis) of Christ, the divine Logos, the divine and the human natures are united in such a way that they are perfectly united without confusion, and at the same time perfectly distinct without separation. Now, the question is: What implications has this hypostatic union for working out a better and more harmonious relationship between science and theology? Let us give it a trial.

The implications of the hypostatic union for science and religion

My aim in this investigation does not include the project of the identification of the humanity and the divinity of Christ with science and religion respectively. Let it be noted from the outset that the ontological perfection of the two natures in Christ is infinitely superior to whatever human intelligence can represent of science and religion in their historical dispensations and actualization. What I propose is to avail myself of the harmony existing between these two natures in Christ as contained in the dogma of hypostatic union, and to set it up as a paradigm for a fruitful and harmonious relationship that might be expected to exist between science and religion. Such a harmonious relationship is presupposed, given the teaching of Pius XI:

> *Scientia, quae vera rerum cognitio sit, numquam cristianae fidei veritatibus repugnant.* [Science as a true understanding of reality can never contradict the truths of the Christian faith.][3]

Such presupposition is always present in the magisterial teachings, because revelation does not contradict human reason and intellect, but perfects them. Pius XII saw science, philosophy and revelation as instruments of truth which "like rays of the sun contemplate the substance, reveal the outline and portray the lineaments of the same creation."[4] Though

Pius XII understood these instruments of truth as rays of the sun, yet, they enjoy a legitimate and healthy autonomy; autonomy both in methods and the objects of these forms of knowing which does not include the slightest separation of the same. Thus, Vatican II insisted that "methodical research in all branches of knowledge, provided it is carried out in a truly scientific manner and does not override moral laws, can never conflict with the faith, because the things of the world and the things of faith derive from the same God."[5] In agreement and in a manner of thinking singular to him, Karl Rahner adds that theology and science "cannot contradict one another since both right from the outset are distinct from one another in their area of investigation and their methodology."[6] The term he employs is "distinct" not "separate," and the choice of such term is not wholly casual.

Now, the hypostatic union concluded that in Christ, the divine and the human natures are united in the one person (*hypostasis*) of the *Logos*, the Son of God, Jesus Christ. In him, these two natures are united perfectly without confusion, and are perfectly distinct without separation. This is the principle of union that I intend to introduce into the relationship between science and religion. These two modes of life and knowledge would naturally be united in and under the reality of the Creator God, who is their source, their principle of action and toward whom they directly or indirectly tend. And just as the two natures of Christ are united in the person of the *Logos*, science and religion should find a point of harmonious union in the God who created humankind and endowed them with intelligence, thus capacitating them to be the masters of the cosmos: and at the same time inscribed in their hearts the undeniable desire for the divine.

It is only science, miserably subjected to and enslaved by the limitedness of the unmediated empirical regulations and the autodestroying arrogance of positivism, that will find it difficult to acknowledge this fundamental situation of the human person as the event of God's absolute self-communication, that is, as a spirit.

What, then, does it mean to say that science and religion should try to be distinct without separation, as is modelled in the hypostatic union? It means that science and religion, by being distinct, are not one and the same thing. This is true with respect both to their proper subject matter and to their methodology. While science has as its proper sphere of examination the physical, palpable, material world, and utilizes the empirical method to realize itself, religion has God and the spiritual realities as its objects of study, depending on revelation from the same God— a revelation, which is, however, rationally grounded in faith. Rahner puts it this way:

> ...[S]cience investigates in an *a posteriori* experience individual phenomena which human beings (ultimately through the experience of their senses) encounter in their world, and the relationship of these phenomena to one another. Theology has to do with the totality of reality as such....[7]

Scientific investigation with its empirico-mathematical method is limitedly precise in most of its findings and conclusions. In comparison, religion depends on the veracity of God, the ground of the totality of reality, who communicates the divine Self to humankind in revelation, and is able to go beyond the limitedness of science. In this, though it may be devoid of mathematical description and the laboratory precision of the scientific investigation, the profession of faith in the divinely revealed truth is not false and cannot be accused of irrationality. The first thing, therefore, in considering any relationship between science and religion, is to be aware of this distinctiveness and to respect it. In line with this thinking, and before he mapped out a line of possible relationship between science and religion, Paul Haffner made it unambiguously explicit that "scientists and theologians had to be careful not to leave their own respective spheres of competence." [8] These specific spheres of competence cannot be negated or overlooked because "while science deals with human investigation of creation, Christian faith [and with it other world religious traditions] treats of the initiative taken by God in revealing that which is beyond the reach of the human mind." [9]

But the hypostatic union teaches further that though the divine and the human natures are distinct, they are not separated. This non-separatedness must now be introduced into the science-religion relationship, because, though they are different means of knowing and living, "this does not mean that the differences between them amount to a total disparity such as to admit of no contact between them, and thereby capable of giving rise to situations of conflict." [10] Science and religion have long existed and supported each other, and there is nothing within them that makes impossible such relationship as that modelled on the hypostatic union. But the regrettable situation today is that the human spirit keeps on seeking to separate science from religion and other metaphysical thinking, or worse still, to set them in opposition. In lamenting the separation of faith from reason, John Paul II specified that such separation had had a serious consequences within the boundaries of scientific investigation. According to him, such a situation has given rise to such a positivistic mentality that disassociates itself from every Christian cosmological vision, refusing to make any reference to metaphysics and moral ethics.[11] Regarding this situation, Haffner writes:

> This perhaps has been due to a sense of power and self-sufficiency deriving from man's greater knowledge of and control over the created reality.[12]

Talking about the positivistic arrogance, Rahner wrote that this mentality can easily

> ...develop in natural scientists, given their *a posteriori* pursuit of science, and—when this tends to become absolute—it is that mentality of positivism, that annoyance with metaphysics, that exclusive confinement to what can be demonstrated by direct experiment, which is liable to produce the arrogance of persons who can present their conclusions as beyond dispute, a mentality which does not have much patience with theology.[13]

Now, in Jesus Christ, the human and the divine natures are perfect, yet none affirmed its sufficiency by neglecting the other or separating one from the other. Because of this, though he knows that he is about to bring Lazarus back to life, such knowledge did not prevent the Lord of life from crying (Jn. 11:35). It is such a harmony that is capable of resolving the problem of the gap actually existing between science and religion. In his meeting with scientists and students in Cologne Cathedral on 15 November 1980, John Paul II spoke clearly about strenthening the connection:

> An adequate solution to the pressing questions about the meaning of human existence, norms of action, and the prospects of a more far-reaching hope is possible only in the renewed connection between scientific thought and the power of faith in man in search of truth. The pursuit of a new humanism on which the future of the third millennium can be based will be successful only on the condition that scientific knowledge again enters upon a living relationship with the truth revealed to man as God's gift.[14]

Lest we live in the world of illusion, the possibility of harmonious mutual teaching, learning and complementation between science and religion should not blind us to the fact that in the objective, everyday spelling out of their internal possibilities in external forum, disagreements and momentary conflicts will surely ensue. Though humankind naturally tends to God, human intelligence and the use of it form an indispensable impulse for human existence. Sometimes, a person is tempted to go beyond the here-and-now ethical boundaries, and in the most cases this is done in "good faith." Such crossing the line may seem like a disobedience of conscience, especially in this age when the custodians of religious traditions, truths and deposits seem to have have little or no weight of authority against the regent democratic systems. This situation is bound to ensure, in regard to certain questions concerning human life and living, some kind of conflict, even if only verbal. (Think, for example, of the conflict between political science and religious ethics—common conscience—in the recent legalization of euthanasia by the government of Holland.) In all, therefore, it is well always to remember:

> It belongs to the very nature of theology to accept that such cases of conflict are possible, even while it hopes, and once more at the eschatological level, that no such case of conflict will be regarded as so radical and so positively insurmountable that the only remaining course is for either theology or the sciences to surrender and submit.[15]

As I have stated above, God, the source and the end of science and religion, guarantees that between science and religion there reigns always a fruitful harmony. Now, God generally is felt in the material world through the instrumentality of the material world itself, and especially through humankind. This competence of ensuring a non-conflictual growth between science and religion, which belongs to God in this model we are proposing, will also be exercised by the divine agents. Given the fact that the sense of the sacred is rapidly ebbing in democratic minds, it becomes the lot of democracy to work out ways of arresting the uncontrolled human desire for scientific and technological discoveries, when it brings along with it the upturn of moral principles inscribed in human hearts. Such a democratic system would also set itself against any irrational encroachments of religion in matters scientific, especially when such scientific advancement does not contradict humanity in its most fundamental essence.

It is true to say that science, given its extension and methodology, is limited in its investigation, as stated above. Philip Quinn made a wonderful "x-ray" of the height and the depths of the practical sciences, departing from the presupposition that scientific laws are logically contingent. He wrote:

> The conservation law for matter-energy is logically contingent. So if it is true, the question of why it holds rather than not doing so arises. If it is a fundamental law and only a scientific explanation is allowed, the fact that matter-energy is conserved is an inexplicable brute fact. For all we know, the conservation law for matter-energy may turn out to be a derived law and so deducible from some deeper principle of symmetry or invariance. But if this is the case, the same question can be asked about this deeper principle because it too will be logically contingent. If it is fundamental and only scientific explanation is allowed, then the fact that it holds is scientifically inexplicable. Either the regress of explanation terminates in a most fundamental law or it does not. If there is a deepest law, it will be logically contingent, and so the fact that it holds rather than not doing so will be a brute fact. If the regress does not terminate, then for every law in the infinite hierarchy there is a deeper law from which it can be deduced. In this case, however, the whole hierarchy will be logically contingent and so the question of why it holds rather than some other hierarchy will arise. So if only scientific explanation is allowed, the fact that this particular infinite hierarchy of contingent laws holds will be a brute inexplicable fact. Therefore, on the assumption that scientific laws are logically contingent and are explained by being deduced from other laws, there are bound to be inexplicable brute facts if only scientific explanation is allowed.[16]

Though Adolf Grünbaum might dismiss this truth of the limitedness of science as defective on the ground that it "is avowedly or tacitly predicted on the spontaneity of Nothing,"[17] he must be ready to face the dilemma that the human person is not only flesh and blood, but is also, in the most fundamental meaning of human existence, the one who listens and awaits the self-communication of the absolute Mystery. Inso far the human person as a spirit supernaturally tends (is ordered) toward God, science will only be sinning gravely against itself if it proceeds in its investigations without any reference to the human person as spirit. Materially speaking, it is only science, condemned to itself and to its criteria, miserably subjected to and enslaved by the limitedness of the unmediated empirical regulations and the autodestroying arrogance of positivism, that will find it difficult to acknowledge this fundamental situation of the human person as the event of God's absolute self-communication, that is, as a spirit. It is really a scientific mentality, absolutizing its poverty and arrogantly refusing to accept its tiredness and dumbness before the infinite sea of the divine, that utters such words as Grünbaum did with regard to creation *ex nihilo*:

> But in all of our ordinary and scientific reasoning, it would be regarded as magical thinking to suppose that any mere thought could bring about the actual existence of the thought-object, let alone out of nothing.[18]

Creation out of nothing surely transcends all scientific operative boundaries, but not for this is it irrational in the sense of a "magical thinking"; rather, it is a mystery before which science, as empirical, will remain silent and will not utter the final word. When of creation *ex nihilo* Michael Buckley held that we "really do not know how God 'pulls it off,'"[19] it constituted for Grünbaum a moment for the demonstration of the unreasonableness of creation out of nothing. But this is not exactly so. That we do not know how God pulls it off is referring itself to that "scandal of unintelligibility," that is, to that intelligence which affirms certain truth like the Trinity or the Incarnation, which as yet are, and ever will be, beyond the grasp of the human intellect. Such a scandal is not meant to represent the defeat of reason; rather, it is meant to bring science and human logic into an immediate contact with their limitedness. If science would be humble enough to be instructed by faith and revelation, science would be fulfilling itself in the same act in which it accepts its limitations.

It is not, however, only science that must be asked to respect its boundaries as it unites itself to faith. Faith and revelation are also expected to be enriched by the ways and the findings of science. Theologians should always have before them the immaterial nature of the question of faith, and in so doing should measure their language and claims to match the mystery of faith. Theology, therefore, which is reflective, would be advised to avoid as best as possible every rigid mathematical claim with regard to the questions of religious experience. In interpreting the content of revelation, theologians should always occupy themselves with working out of the truths which aid the human person on the way to God; and when this involves making reference to the laws of the physical reality, they should always be prudent enough to be instructed by the experts in this field, allowing in all things room for the ineffability of the mystery and avoiding mathematical precision, which is unnecessary and does not enter within the legitimacy of theology's competence. In this way, theology will be saved the sort of embarrassment as has been witnessed in the past; with this kind of attitude, the Church can avoid the accusation of being too rigid and quick to condemn. Karl Rahner reminds us of the historical problem:

> For a long time the church resisted the heliocentric system of Copernicus. For a long time it tried to hold onto a fixity of the kinds of living beings by appealing to the account of creation in the Book of Genesis. For a long time it rejected the biological emergence of humankind from the animal kingdom and fought against it. In *Humani Generis* and in a schema prepared for Vatican II it taught that the origin of all human beings begins from a numerically single pair. In reprimanding Teilhard de Chardin and repressing his endeavours it manifested too little understanding for an ontology in which created being is conceived in principle and in the very beginning as being which is in the process of becoming within an entire evolution of the cosmos, which is still in the process of becoming. The church has often shown too little understanding toward those branches of anthropology in which the material, biological reality of the human being as such is validated.... The church was always quicker to say no that to say yes.[20]

Beyond these physical realities whose internal laws science is trying to master, the Church should also avoid taking advantage of the here-and-now limitations of science and technology, offering them as proofs of the existence of and the ground for God and spiritual realities. Haffner states the risk:

> [O]nce this gap in our knowledge is closed, our belief in God may be compromised. This error is known as that of the God of the gaps, and is a reduction of the doctrine concerning God. Why should He be placed only at the point of human ignorance, rather than in the universe as a whole and also beyond it in His transcendence.[21]

Rahner was of the same view from the point where he started:

> The question and the method of a metaphysical theology do not occur as a consequence of the natural science having reached their utmost limits, nor are they extrapolated from these sciences.[22]

The desire to keep science and theology together in the human self-realization should, however, not blind us to the danger inherent in not recognizing the undeniable difference between them. The case at hand is that of Richard Swinburne, who, insisting on the methodological continuity between science and theology, concluded:

> The very same criteria which scientists use to reach their own theories lead us to move beyond those theories to a creator God who sustains everything in existence.[23]

That Swinburne can attain to the existence of God cannot be doubted, but that he does it with the same very scientific criteria employed by the positive scientists makes me uncomfortable. Unless the affirmation is only a piece of poetry in which scientific "criteria," "God," and "theories" acquire meaning more than normally contained in them, one must prudently admit that Swinburne, in writing these words, had "a slip of thought." No one can employ the scientific method and claim to enter the sphere of the divine, because "natural science may and should be methodologically atheistic." [24] Haffner also insisted that "...scientific language cannot approach God the creator, for He is beyond its sphere of competence." [25] Scientific criteria as practical, then, can lead to God only when sinning against the intellect; scientific criteria as such are subverted.

Grünbaum might be considered right if he rejects Swinburne's claim. In fact, following the traditions of such thinkers as Bertrand Russell, David Hume, and Santayana, he accused Swinburne's claim of being "epistemologically frivolous by being altogether *ex post facto*." [26] According to him, an *ex post facto* explanation is that which "is neither retrodictive or predictive and whose premises have no corroboration by evidence independent of the given *explanandam*." [27] Over and against this theistic *ex post facto* explanation presented by Swinburne, Grünbaum set such explanation as the gravitational explication of the orbit of the moon offered by Newton, the deductive-nomological argument advanced by Maxwell's equations for explaining optical and other electromagnetic phenomena, or the genetic explanation of the hereditary phenotypic resemblance present in the human family. We may not accuse Grünbaum of falsity, but he has not got the final word. Though a strict scientific methodology might find it difficult to go beyond itself, it does not mean that human knowledge is delimited by the boundaries of scientific method. The human person as a spirit in the world can always transcend this scientific limitations, and this is done specifically through a response in faith to the self-communication, explicitly or implicitly, of the absolute Mystery.

> [This] occurs when the knowing subject, instead of focusing its attention on this or that particular object of the a posteriori experience, asks itself, in a total return to itself, about the conditions of the possi-

Theology, which is reflective, would be advised to avoid as best as possible every rigid mathematical claim with regard to the questions of religious experience.

> bility of subject and of a knowledge and a freedom which have a reflexive knowledge of themselves: when thinking and freedom think themselves.[28]

Acknowledging this transcendental dimension of humanity, science must not turn itself into an absolute autonomy in its search for the meaning of existence. It is an autonomous discipline, but its autonomy is not absolute, "because no discipline can furnish a complete view of the whole gamut of human experience. Thus each science needs to be complemented by other spheres of knowledge."[29]

Today, with enormous autonomy, laudable precision, and advancement even in areas previously unimaginable, science is challenging religion, correcting erroneous religious beliefs, and determining increasingly the way religion thinks of itself and its competence.

Because of the aforementioned reasons and limitations, Grünbaum cannot, no matter the logicalness of his argumentation against Swinburne, and the harshness of and the illegitimate jump made by Swinburne's conclusions, dismiss the truth of a creator God and the theological conclusions inherent in it as totally devoid of truth. Both he and Swinburne should see in the hypostatic union, that is, in Christ, a way of solving this specific problem, thus establishing a better relationship between science and religion—between the scientific method and the life in divine revelation, and between the scientific spirit and the religious spirit which can harmoniously exist in one given individual—and participating, in this way, in the new era which John II was inaugurating in 1980 when he addressed the twelve Nobel Prize winners:

> ...the issue today is no longer that of opposition between science and faith. A new period has begun: the efforts of scientists and theologians must now be directed to developing a constructive dialogue.[30]

Conclusion

Having come thus far, I would like to state my personal conviction. Bringing science and religion into a relationship ordered according to the pattern of the hypostatic union means that science and religion must learn to know themselves and be able to complement each other in the very same act in which they respect their distinctiveness. Each practical science occupies itself with a specific area of human living (medicine for example), and tries to specialize in it, while religion deals with the original truth in its wholeness. And for this, science must respect religion even in the poverty of religion's language to express the truth concerning the ultimate question about human existence. In the words of Rahner:

> ...the truth of religion...is *a priori* to a scientific picture of the world.... Since the truth of religion...is already in possession at that point in the existence of man where lie the presuppositions of science, which it itself cannot go beyond, the world-view presented by science is not a court of appeal against religion. Certainly, we must always insist on and work for the fact that there should be no double truths, that is, truths contradicting one another, that genuinely sober, careful science, conscious of its limitations and its hypothetical character does not contradict faith, that in the case of an apparent conflict both sides must seek in honest self-criticism where the reason for the apparent contradiction is to be found, but religion is not thereby simply at the mercy of science and its world-view.[31]

There is no denying that, at times in the past, religion applied heavy pressure upon science, sometimes crippling its legitimate advancement and desire for novelty. The scientists of the time were practically under the dictate of the religious authority; they could not assert themselves, in part because science itself did not have sufficient proofs to convince itself of the validity of its findings. The situation today is very different, if not the exact opposite. Today, with enormous autonomy, laudable precision, and advancement even in areas previously unimaginable, science is challenging religion, correcting erroneous religious beliefs, and determining increasingly the way religion thinks of itself and its competence. And most of the time, this is accomplished before a religious authority that can no longer abort at will even the crudest of the scientific research and findings. The way out of this situation of confrontation is to cultivate a harmonious co-existence in respect and mutual fulfillment, having as a paradigm the hypostatic union. This may sound like a piece of poetry, but it is something existentially possible. An example of such an existential possibility is found in the person of Ian Wilmut, who along with his team cloned Dolly, the first of its kind in the history of cell manipulation. Though he has this technological power within his hands, and as a scientist might heavily be tempted by curiosity and the desire for novelty, he is still against human cloning (at least for now) and calls it "criminally irresponsible."[32] In order for this example that he sets to become more common among scientists, theologians need to be sufficiently instructed in the ways of the sciences; and scientists need to be persons of faith who acknowledge their limitations as creatures. The way out is the model of the hypostatic union: scientist-theologians who are scientifically theological in method, and theologian-scientists who are theologically scientific in method.

Works cited:

Buckley, Michael. "Religion and Science: Paul Davies and John Paul II." *Theological Studies* 51 (1990: 310-24..

Denzinger, Heinrich. *Enchiridion Sumbolorum*. No. 301-302. Bologna: Edizioni Dehoniane (EDB), 1996.

Gibbs Nancy, "Renegade scientists say they are ready to start applying the technology of cloning to human beings. Can they really do it, and how scary would it be?" *Time Magazine* 157 (19 February 2000): 32-43.

Grünbaum, Adolf. "A New Critique of Theological Interpretations of Physical Cosmology." *The British Journal for the Philosophy of Science* 51, no. 1 (2000): 1-43.

Haffner, Paul. *Mystery of Creation*. Herefordshire: Gracewing, 1995.

_____. "Christian Faith in God the Creator in Relation to Modern Science according to the Works of Stanley L. Jaki" (unpublished doctoral thesis). Theses Pontificiae Universitatis Gregorianae 731.

John Paul II, Pope. *Fides et Ratio*. Casale Monferrato: Edizioni Piemme, 1998.

_____. *Insegnamenti di Giovanni Paolo II*, 3/2. Vatican City: Vatican Polyglot Press, 1980.

O'Collins, Gerald. *Christology*. New York: Oxford University Press, 1995.

Pius XI, Pope. *Acta Apostolicae Sedis*. Rome: Vatican Polyglot Press, 1909.

Pius XII, Pope. *Discourse on the Pontifical Academy of Science* (22 November 1951). In *Discourses of the Popes from Pius XI to John Paul II to the Pontifical Academy of Sciences, 1936-1986*. Vatican City: Pontifical Academy of Sciences, 1986.

Vatican II Council. *Gaudium et Spes*. 1965.

Rahner, Karl. "On the Relationship between Theology and the Contemporal Sciences." In *Theological Investigations*, vol. 13, 80-102. London: Darton, Longman & Todd, 1975.

_____. "Natural Science and Reasonable Faith." In *Theological Investigations*, vol. 21, 16-55. London: Darton, Longman & Todd, 1979.

_____. "Science as a 'Confession.'" In *Theological Investigations*, vol. 3, 385-400. London: Darton, Longman & Todd, 1979.

Swinburne, Richard. *Is There a God?* New York: Oxford University Press, 1996.

Endnotes:

1. Denzinger, no. 301-302.

2. O'Collins, p. 192.

3. Pius XI, p. 421.

4. Pius XII, p. 84.

5. Vatican II Council, § 36.

6. Rahner, "Natural Science and Reasonable Faith," p. 19.

7. Ibid.

8. Haffner, *Mystery of Creation*, p. 174.

9. Ibid. p. 157.

10. Rahner, "On the Relationship between Theology and the Contemporal Sciences," p. 94.

11. John Paul II, *Fides et Ratio*.

12. Haffner, *Christian Faith in God the Creator*, p. 14.

13. Rahner, "On the Fundamental Relationship between Theology and Natural Science," p. 23.

14. John Paul II, *Insegnamenti di Giovanni Paulo II*, p. 1210.

15. Rahner, "On the Relationship between Theology and the Contemporal Sciences," p. 101.

16. Quoted in Grünbaum, pp. 17-18.

17. Ibid., p.19.

18. Ibid., p. 23.

19. Buckley, p. 314.

20. Rahner, "Natural Science and Reasonable Faith," p. 25.

21. Haffner, op. cit., p. 164.

22. Rahner, op. cit., p. 22.

23. Swinburne, p. 2.

24. Rahner, op. cit., p. 19.

25. Haffner, *Mystery of Creation*, p. 157.

26. Grünbaum, p. 21.

27. Ibid., p. 22.

28. Rahner, op. cit., p. 22.

29. Haffner, op. cit., p. 165.

30. John Paul II, op. cit., p. 1784.

31. Rahner, "Science as a 'Confession,'" p. 387.

32. Gibbs, p. 38.

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A Conversation on Divine Infinity and Cantorian Set Theory

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This essay is written as a drama that opens with Aristotle, St. Augustine of Hippo, St. Thomas Aquinas, and Nicholas of Cusa debating the nature and reality of infinity, introducing historical concepts such as potential, actual, and divine infinity. Georg Cantor, founder of set theory, then gives a lecture on set theory and transfinite numbers. The lecture concludes with a discussion of the theological motivations and implications of set theory and Cantor's absolute infinity. The paradoxes inherent in analyzing absolute infinity seem to provide a useful analogy for understanding God's unknowable nature and the divine relation to creation.

Introduction

This essay is an introduction to the philosophy, theology, and mathematics of the infinite, written as an imaginary conversation among the following figures:

- **Aristotle** (384-322 B.C.E.): a classical Greek philosopher whose ideas on philosophy, science, ethics, and politics defined pre-Enlightenment Western thought and remain enormously influential today.
- **Augustine of Hippo** (354-403 C.E.): a North African whose Neo-Platonic writings represent the first major philosophical treatment of Christian thought and laid the intellectual foundations of Western Christian theology.
- **Thomas Aquinas** (1224-1274 C.E.): an Italian Dominican who sought to integrate Aristotelian and Christian thought. His sytematic approach to theology defines the Scholastic tradition and remains especially influential in the Roman Catholic tradition.
- **Nicholas of Cusa** (1401-1464 C.E.): a German cardinal who wrote on a wide variety of subjects, especially mysticism, mathematics, and the infinite. He is best known for his belief that human knowledge is necessarily incomplete.

After these figues rehearse the development of premodern thought on the infinite, **Georg Cantor** (1845-1918 C.E.), the Russian-born mathematician whose set theory revolutionized thinking about infinity and launched the first successful attempt at a theoretical justification for mathematics, gives a lecture on modern mathematics of the infinite. Finally, everyone responds to Cantor's ideas, briefly developing set theory's theological importance for the conception of divine infinity.

The primary aim of this essay is not to develop a comprehensive theology of the infinite, but to make available the detailed background in theology and mathematics necessary for such a study and to suggest areas of application that may prove fruitful for further research. Though the speakers use contemporary language and a casual tone, each character's remarks represent their actual thoughts; detailed references direct readers to sources for more extensive treatment. If this essay provokes a fuller examination of set theory and theology, it will have been successful.

Setting

A small room with a table and a few chairs. Paper tablets and pencils are stacked neatly on the table. There is a window on one side of the room. The end wall is covered by a chalkboard.

[Four men enter through the main door.]

Nicholas of Cusa:

I thought I'd never find this place—glad I bumped into the rest of you.

Aristotle:

I still don't see the point of this. This lecturer can't have anything new to say about infinity. It's just an idea, and an unrealizable one at that.[1]

Augustine, Bishop of Hippo:

What about God?

Aristotle:

What's infinity got to do with the gods? It's a quantitative notion derived from the physical world. Imagine some large quantity or magnitude. Can't you always enlarge it by adding to the initial amount? No matter how much you add, it's always possible to add more. The infinite can never be actualized.[2]

Thomas Aquinas:

You certainly seem to have shown that infinite quantity and magnitude don't exist, but what's that to do with God, who has neither quantity nor magnitude?[3] Didn't you say in *Physics* that some non-physical entities—like time and motion—are actually infinite?[4]

God provides signs and tools analogous to divine characteristics that help us understand. Mathematical infinity is analogous to divine infinity, so we can use the former to glimpse at the nature of the latter.

[Augustine]

Aristotle:

You don't quite understand *Physics*, do you? Motion and time have always existed, but only because there is no concept of *before* without the existence of time. Time is eternal, but it isn't infinite: Time is bounded in the past by the prime mover (whom you call God) and in the present by "now." That which is bounded is not infinite.[5]

Augustine:

Stop! You began by talking about unattainable quantities and magnitudes; now you're referring to anything unlimited. Your first notion of infinity applies only to amounts; let's call that quantitative infinity. Your second notion of infinity—that which is without limit—includes and goes beyond quantitative infinity. Let's call that divine infinity since it's related to God.[6]

Nicholas:

Definitions won't get us very far. If the infinite is without limit, how can we limited humans grasp it? And if definitions are limiting, how can they help us to contemplate the divine?[7]

Aristotle:

And why use the word *infinity* in both definitions? Infinity has to do with measurement, and you cannot measure the divine.

Aquinas:

But you just equated limitlessness and infinity, and limitlessness is inherent in God's being, which is not something countable like a bundle of sticks.[8]

Aristotle:

You can't speak of infinity as if it were an intrinsic property of some objects![9]

Nicholas:

But God isn't an object. God is infinite—but much more so than a bottomless pit or an endless sequence. He is the Absolute Maximum and the Absolute Infinite. All other notions of infinity are inferior to God's perfect infinity.[10]

[Aquinas and Aristotle look puzzled.]

Augustine:

Maybe Nicholas means that divine and quantitative infinity aren't unrelated, so using *infinity* in both definitions makes sense. God is beyond notions of quantitative infinity, but quantitative infinity may be an imperfect shadow of divine infinity.[11]

Aristotle:

Don't get Platonic on me. Nicholas just said God is perfect, but if God is perfect then God is not infinite: Infinity implies imperfection and indefiniteness. Perfect objects are complete and harmonious, like perfect geometric figures.[12]

Aquinas:

I think you're confusing the two infinities again. Unlike all other items, God's infinity is essential to His being, so God is both divinely infinite and perfect. He is beyond the form and matter implied by mere quantitative, imperfect infinity.[13]

Augustine:

Right. Divine infinity just seems indefinite because you can only understand it in terms of quantitative infinity.

Nicholas:

Yes, but humans can never know divine infinity. Consider a line. We can't conceive of a perfect line, because it doesn't exist in nature for us to observe. We can approach perfection through geometry, but even that doesn't work in the end. When we try to imagine infinite lines, all we really get are imperfect portions and finite imitations.[14]

[Aquinas stifles a snigger.]

Aristotle:

You Christians—hindsight is easy! I know we can't imagine actual infinite quantities—they don't exist! Infinity, however, is real in this sense: Imagine a yardstick. Take away half of it and you have 18 inches. Take away half again and you have 9, then 4 $^{1}/_{2}$, then 2 $^{1}/_{4}$, and so on. You can proceed in this manner forever and some of the original yardstick will always remain. Thus the yardstick, and by extension all magnitudes, are infinite by division.[15]

Nicholas:

But you'll never accomplish an infinite number of divisions. It would take forever, and you yourself argued that time isn't infinite.

Aristotle:

Correct, so I say the yardstick is *potentially* infinite rather than *actually* infinite, since to actually produce infinitely many divisions would require an infinite length of time and an infinitely fine cutting tool. The idea of infinity is inherent in the process of dividing. The reason people are fooled into believing that infinitely large magnitudes actually exist is that the process of adding to a pile or lengthening a line seems to point to such potential infinities in nature.[16]

Augustine:

So the notion of infinity is clear enough.

Nicholas:

What arrogance! No one can understand infinity—even potential infinity—except God. You think you can see the infinite, but God is beyond anything that's observable. To use Aristotle's terms, God is both ultimate potentiality and ultimate actuality. He is actualized possibility and possible actuality, beyond both potential and actual infinities.[17]

Augustine:

Divine qualities are difficult but not impossible to grasp for the faithful. God provides signs and tools analogous to divine characteristics that help us understand. Mathematical infinity is analogous to divine infinity, so we can use the former to glimpse at the nature of the latter. Similarly, Man was created in God's image, so our minds are the best tools for understanding the mind of God.[18]

Nicholas:

No. When we say, "God is infinite" or "God is perfect," we categorize God according to human ideas of perfection or infinity. God is more perfect than we can possibly imagine, so ascribing to Him worldly traits paints a limited picture of God. Similarly, God is *more* infinite than we can conceive—Oh, this quantitative language is useless! God is the Absolute Maximum—words don't really apply to Him.[19]

Augustine:

But if we have faith, God can reveal spiritual nature through physical analogs. Didn't you say mathematics is the most perfect tool we have? The possibility of infinite numbers can tell us something about God's unlimited nature if we allow the divine words to speak within us.[20]

Nicholas:

I agree that analogy is the only constructive way to talk about God and that mathematics is probably the best analogy to use for the divine. Still, God has created a spatially infinite universe for us to ponder, but that spatial infinity is not like divine infinity.[21]

We cannot know whether the ideas in our limited minds accurately describe God, even in some limited way. Language doesn't help at all; it just tempts us into thinking we know more about God than we actually do.

[Nicholas]

Aristotle:

We've already been over the fact that spatial infinity does not and cannot exist! It's paradoxical to suggest that even a divinely infinite god can create the impossible.[22]

Augustine:

It only seems like a paradox because, though man was created in God's image, we cannot understand His nature without help. If God were to reveal the true nature of infinity and His being, we'd be able to resolve the paradox.[23]

Aristotle:

I don't know about the need for divine revelation, but I do agree that most difficulties can be avoided if crucial concepts are properly understood. Zeno's paradoxes gave my contemporaries fits until I demonstrated that they vanished with proper understanding of potential infinities. Apparent contradictions must always yield to reason in the end, even the contradictions we've discussed regarding divine infinity.[24]

Nicholas:

You're both mistaken about paradox. Mere words will always fail to describe God. Paradoxes are not only inevitable, they are necessary if we hope to know what we cannot say about God.[25]

Aquinas:

I agree that we cannot fully know God. We can make statements about God, however—like "God is good"—but we know those words are wholly inadequate to describe God's actual divine goodness.[26]

Nicholas:

I wouldn't even go that far. We cannot know whether the ideas in our limited minds accurately describe God, even in some limited way. Language doesn't help at all; it just tempts us into thinking we know more about God than we actually do. Only "negations are true and affirmations are inadequate."[27]

Aquinas:

But if language is inadequate, negations about God cannot be any more accurate than assertions about God!

Nicholas:

No. If I say "God is not weak," I'm not implying "God is strong." Negations are correct because they refrain from describing God. The more we seek to use words about God, the more words fail us. Paradoxes like "God is infinite and perfect" or "Jesus was God and man" are not results of poor definitions. They highlight language's imperfection and force us to abandon words when contemplating God. We must embrace our ignorance of God and move beyond words, beyond sensory perception. The only true way to know God is through the mystical experience, and even then we just see more clearly that we do not know God. Sill, this ignorance makes us wiser because we understand that we do not and cannot know God.[28]

Aquinas:

I'm still not convinced that a paradox exists. Language may be inadequate, but God can't be both finite and infinite, for example.

Augustine:

I agree with Thomas. A language paradox doesn't necessarily prevent us from understanding divine infinity. Nicholas says we can't know God, but we *were* created in God's image. Only sin prevents us from fully knowing God.[29]

Aristotle:

Pious rubbish! You don't need divine help to understand divine infinity. Just read *Physics* and *Metaphysics*. I cannot understand a prime mover's existing beyond magnitude and time, but only because I wasn't around when the world was created. We humans have no experience with things outside of place and time.[30]

Augustine:

But God can lead us to understanding.

Nicholas:

[Impatiently] No! We can't even figure out regular infinity! Are you listening to me? Look, divide an infinite line in half and each half must still be infinite.[31] Don't try to tell me you understand that. The diagonal of a square is incommensurable with its sides.[32] We can see the diagonal as plain as day on paper, but no fraction can accurately describe it. Infinity is like that. It's deceptively simple, and we seem to understand it through analogy, but some power greater than reason and mathematics, greater than our created intellect, is necessary to truly comprehend it.[33]

Aquinas:

I don't know about that. I'm sure I can understand potential infinity.

Augustine:

At the very least, the notion of reaching infinity by counting is clear. We never get to the top of Jacob's ladder.

[Nicholas stares at his companions incredulously.]

Nicholas:

Didn't you hear what I just said? Did I slip into French by accident?

Aristotle:

No need to get so upset, Nicholas. Still, maybe infinity isn't as simple as I thought. This lecturer might be useful after all.[34]

Aquinas:

We're about to find out; here he comes.

[A slightly disheveled man rushes into the room.]

Georg Cantor:

[Winded] Sorry I'm late, but my last talk lasted longer than I expected. Our time is short, so if you don't mind I'll give my presentation straight away. Afterwards we can discuss any questions.

[The class take up their tablets. Cantor unfolds some papers from his pocket, walks to the blackboard, and picks up some chalk.]

Cantor:

Mathematicians, philosophers, and theologians have struggled to understand infinity for thousands of years. The concept of infinity was central to the worldview of the earliest Greek thinkers,[35] but Aristotle pushed it to one side, claiming—

Aristotle:

[Interrupting] There is no need to be offensive.

[Cantor looks up from the blackboard. He suddenly recognizes his students.]

Cantor:

Oh my! You four are much more sophisticated than most classes. I think I'll skip my introduction and get straight to the new stuff. Aristotle was right to say that infinity cannot be reached by counting things or adding to them. To understand infinity, we have to abandon the rules of finite arithmetic. Let me use an analogy.[36]

[Augustine grins; Nicholas groans.]

Cantor:

Hebrew and Greek are both languages, but you can't speak good Greek using Hebrew grammar. Similarly, you can't speak clearly about infinity using the grammar of finite arithmetic. Proper non-finite arithmetic starts with ordinal numbers. Ordinal numbers designate places within a sequence. Finite numbers like 2, 5, 11 all have corresponding ordinals: second, fifth, eleventh (I'll use this color to identify ordinals); likewise, n denotes the nth position in a well-ordered sequence. Every ordinal n has a successor, n^+. In finite arithmetic, n^+ is equivalent to $n + 1$.[37] You can use ordinals to describe any group of objects that can be lined up in a row, and any such group taken as a whole is called a set. The mathematics of sets is called set theory. Is everyone with me so far?[38]

Augustine:

I think so. The ordinal 20 describes a container with twenty places. When you put twenty objects into it they compose a set with 20 members.

Cantor:

Exactly. Now, for finite sets the number of positions in the set equals the number of objects in that set.[39]

Aquinas:

[Impatiently] How obvious can you get?

Cantor:

Just hold on. I want you to imagine the natural numbers[40]—all of them. I use the symbol ω to indicate the number of places in the set of natural numbers.[41] You can think about ω as follows: For every sequence of finite ordinals $n_1, n_2, n_3, \ldots$, there are ordinal numbers a such that $n_k < \alpha$, for all **k**.[42] I call numbers like α *transfinite*. ω is the "smallest" of these. It encompasses all the finite ordinals but cannot be reached by counting.

Aristotle:

But you just said ω corresponds to an unattainable quantity! How can it exist?

Cantor:

Hold your horses! Remember the analogy to Greek and Hebrew? 2, 5, 11, and ω are all ordinals, but you need transfinite arithmetic to talk about ω and finite arithmetic to talk about 2, 5, and 11. Like most languages, finite and transfinite grammars have some similarities: They both include the succession rule. Thus ω has a successor ω^+, represented by $\omega \oplus 1$,[43] and we can continue building successors (like $\omega \oplus 2$, $\omega \oplus 3$) until we reach $\omega \oplus \omega$.

[Aristotle begins to interrupt, but Cantor stops him.]

Cantor:

I know. I just said that finite and transfinite numbers follow different rules, and then I seemed to use ordinary addition on transfinite numbers; but transfinite arithmetic really is quite different. For example, $2 + 1 = 1 + 2$, but $\omega \oplus 1 \neq 1 \oplus \omega$. Remember, sets are containers where each object occupies a unique position. Consider the set containing all natural numbers and a bicycle. How long is the row? For transfinite ordinals, it depends on how you arrange the objects. Let's put the bicycle in first:

Positions in the set:

1, 2, 3, 4, ... ω

Objects in the set:

🚲, 1, 2, 3, ... ∞

Since the natural numbers are infinite, you can put infinitely many objects into an w-sized set as long as these objects occupy distinct numbered positions. So $1 \oplus \omega = \omega$ in transfinite addition. But watch what happens if we save the bicycle for last:

Positions in the set:

1, 2, 3, 4, ... ω, $\omega \oplus 1$

Objects in the set:

1, 2, 3, 4, ... ∞, 🚲

You can fit all the natural numbers into ω positions, but there's no room left for the bicycle. We need a set with $\omega \oplus 1$ places to hold everything. Thus $\omega \oplus 1$ is longer than ω, since it denotes an ordering requiring more than ω places. Transfinite multiplication behaves analogously:

$$2 \otimes \omega = 2 \oplus 2 \oplus 2 \oplus 2 \oplus \ldots = \omega,$$
$$\text{whereas } \omega \otimes 2 = \omega \oplus \omega.$$

I just said that finite and transfinite numbers follow different rules, and then I seemed to use ordinary addition on transfinite numbers; but transfinite arithmetic really is quite different.
[Cantor]

Aquinas:

It's contrary to reason!

Nicholas:

Counter-intuitive, perhaps—

Cantor:

Of course $\omega \otimes 2$ is just the beginning. If we continue using the principles of ordinal generation, we quickly reach sets that exhaust normal mathematical notation. Consider the following sequence of transfinite ordinals:

$$\omega, \ldots\ \omega \otimes 2, \ldots\ \omega \otimes 3, \ldots\ \omega^2,$$
$$\ldots\ \omega^2 \oplus \omega, \ldots\ \omega^2 \otimes 2, \ldots\ \omega^3, \ldots\ \omega^4,$$
$$\ldots\ \omega^\omega, \ldots$$

There's no end in sight. We can create ω^ω by multiplying together infinitely many ωs. It describes an incredibly long row, but we can multiply ω^ω by ω^ω to get an even longer one. If we keep going we'll reach a stack of exponential ωs that's ω symbols high, a barely conceivable number.

Aristotle:

[Smugly] Yes, but you still won't have reached actual infinity. You're just performing some kind of turbo-charged transfinite counting. We can go farther if we invent new notation. Suppose $\underline{\omega}$ represents the exponential tower of ωs that's ω units high. I can then continue creating larger ordinals (starting with $\underline{\omega} \oplus 1$) until I reach a tower of $\underline{\omega}$s that's $\underline{\omega}$ units high. I can always invent new notation for longer and longer rows, but I'll still never reach actual infinity—it is potential after all.[44]

Cantor:

Aristotle is on the right track, but ordinal numbers are not really counting numbers. The set containing a bicycle and the natural numbers can be ordered so as to contain ω or $\omega \oplus 1$ places—but it still contains the same number of objects. In order to get a grip on the size of a set, we have to learn to count with transfinite cardinal numbers.[45] Consider these sequences:

1	2	3	4	5	6	7 ...	n...
2	4	6	8	10	12	14 ...	2n...

Reason suggests that there are twice as many natural numbers as even numbers, but we can exactly pair every natural number with an even number. The sets are the same size!

Aquinas:

Another paradox![46]

Cantor:

Not really. Two sets have the same *cardinality* if every object in one set can be uniquely matched to an object in the other. In finite sets ordinals and cardinals are trivially equivalent, but for transfinite numbers the difference is crucial. We can count up to Aristotle's $\underline{\omega}^{\underline{\omega}}$ and beyond, but in fact every transfinite number we've seen so far has the same cardinality as ω itself.

Augustine:

Can you give an example?

Cantor:

Imagine a library with infinitely many shelves. We can fit an infinite number of books into the library and still have room for two more. We just put these additional books at the beginning of the first shelf and move every other book down two places:

Shelf position:
0, 1, 2, 3, 4, ... ω

Book number:
$\infty + 1$, $\infty + 2$, 0, 1, 2, ... ∞

Aquinas:

So you can fit $\infty + 2$ books into ω spaces. Just like we did with the bicycle!

Cantor:

Right. Order doesn't matter for cardinals. You can rearrange objects however you like to create a one-to-one correspondence—only essential size matters. Determining the cardinality of the ordinals we have seen so far does get more complicated, but with patience we can show that they all have the same cardinality as ω.[47]

Augustine:

I like your proof, but how do we reach larger cardinal numbers?

Cantor:

Well, $\aleph_0$,[48] the first transfinite cardinal, represents the cardinality of ω and all successive countable ordinals.[49] We eventually surpass all countable ordinals and reach $\aleph_1$, the first uncountable transfinite cardinal. It represents the first set whose contents cannot be placed into a one-to-one correspondence with the natural numbers. It is uncountably infinite.[50] You might think that even though you can get to $\aleph_1$, the sets with cardinality $\aleph_0$ are sufficient to tackle any mathematical problem. In fact, higher cardinalities are central to one of the most exciting problems in mathematics—the nature of the real number line.[51] In 1874 I completed a controversial proof showing that the number of points on a continuous line is uncountable. Although I didn't use modern terminology, I proved that the cardinality of the real number line is greater than $\aleph_0$. Later I worked out how to produce sets of greater cardinality from any given set.[52] This involves power sets, where the power set of S ($\mathscr{P}$S), is the set containing all subsets of S. The cardinality of $\mathscr{P}$S is 2^S.[53] Now, consider $\mathscr{P}$N, where N represents all the natural numbers—

Aquinas:

Wait. We've seen enough to know that analogies between the finite and transfinite are problematic.

Cantor:

You're right, but this analogy is an instructive one: $\mathscr{P}S = 2^S$ holds whether S is a finite or transfinite set. Thus you can go beyond $\aleph_0$ by taking $\mathscr{P}$N, which I proved represents the cardinality of the continuum. So the real number line has cardinality $2^{\aleph_0}$, which is greater than $\aleph_0$.[54]

Nicholas:

Amazing! Does the cardinality of the continuum, $\mathscr{P}$N, equal $\aleph_1$?

[Cantor sighs forlornly.]

Cantor:

You've hit on the million-dollar question. I have always believed $\mathscr{P}N = \aleph_1$. Because the continuum has cardinality $2^{\aleph_0}$,[55] I knew that if I could show $\aleph_1 = 2^{\aleph_0}$, or more generally $\aleph_{n+1} = 2^{\aleph_n}$, I could elegantly link all the transfinite cardinals with real numbers and power sets generated from the natural numbers. $\aleph_1 = 2^{\aleph_0}$ is called the Continuum Hypothesis. Set theory developed largely through my exploration of the real numbers and desire to prove the Continuum Hypothesis. Unfortunately, I was never able to prove it, and after my death mathematicians showed that the Continuum Hypothesis can be neither proved nor disproved using the assumptions of standard set theory.[56]

Nicholas:

I like this. Logic has proven that truth lies beyond logic!

Aquinas:

Well, at least now we can explain Aristotle's infinite divisibility and Zeno's paradox. Both cases are attempts to analyze a continuous line in countable terms. If you didn't know that the set of real numbers is essentially larger than the set of natural numbers, it'd be easy to get confused.

Aristotle:

Yes, I guess that does make sense. Every transfinite cardinal applies to an infinite number of transfinite ordinals, but there's still no foreseeable end to the ladder of infinities you've created. Though transfinite cardinals beyond $\aleph_1$ can't be reached by counting, surely you can go beyond $\aleph_1$ and reach cardinals such as $\aleph_2, \aleph_3, \ldots \aleph_\omega, \aleph_{\omega+1}$ and so on. When will it all end?

Cantor:

Never, if you keep trying to count your way through the transfinite. But look, we know sets contain objects in ordered rows. Why don't we just collect every set and create the set of all sets? Call it Ω.[57]

Aristotle:

Can you do that?

Nicholas:

[Smiling mischievously] Come on, think! Don't you remember the principles of ordinal generation Cantor laid out earlier?

Augustine:

I remember! Every ordinal n has a successor n^+; every well-ordered set is associated with an ordinal number—

Aquinas:

That means Ω must correspond to the largest possible ordinal. But if there is an ordinal number for Ω, a successor ordinal Ω⁺—and therefore a set larger than Ω—must also exist.

Aristotle:

But by definition Ω contains all sets, so the set Ω⁺ must be contained in Ω. Impossible!

Nicholas:

Yes! In other words, no container can contain all possible containers, including itself.

Cantor:

Well done, Nicholas. You've just uncovered the paradox of the largest ordinal.[58]

Augustine:

What's the solution?

Cantor:

The problem comes from misunderstanding the definition of set. A set is an ordered row of objects, not a group that meets a condition for inclusion such as "the set of all sets." You four just deduced that there is no largest ordinal, and that the collection of all sets isn't a set.[59]

Aristotle:

So Ω doesn't *actually* exist. It doesn't even *potentially* exist.

Cantor:

Ω exists, but the totality of all containers cannot itself be a container—think about it. Look, "the collection of all possible thoughts" is an unthinkable thought, because if you imagine the totality of all thoughts, the idea of thinking all possible thoughts becomes a thought not contained in your original collection.[60] This doesn't mean the sum of all possible thoughts doesn't exist, just that the sum cannot be a thought. Analogously, Ω exists, but it is not a set: We cannot say anything definite about Ω using set theory. It represents *absolute infinity*, which transcends set theory and can only come from God.[61]

An ontological gap exists between the finite and transfinite sets described by set theory and Ω—a gap that we cannot bridge without something beyond mathematics to help us.

[Augustine]

Augustine:

Yes, you must go beyond mathematics to understand Ω. We've used set theory to reach ever larger transfinite numbers, but set theory itself points us towards the absolute infinite. We can try to use set theory as an instructive analogy for Ω, but an ontological gap exists between the finite and transfinite sets described by set theory and Ω—a gap that we cannot bridge without something beyond mathematics to help us.

Nicholas:

I'd go even further than that. Like divine infinity, Ω represents a paradox that highlights our inability to understand the one true and complete infinity.[62]

Cantor:

Nicholas, you are eerily perceptive. I've finished my presentation on set theory sooner than I expected, so we've got some more time for discussion.

Aquinas:

I think set theory has some interesting theological implications. Have you ever considered doing any systematic work in that direction?

Cantor:

As a matter of fact, I've thought quite a lot about the theological implications of my theory. Most people don't know this, because during my lifetime set theory was very controversial, and I was forced to downplay the theological implications of my theory in most publications.[63] It was God who revealed the transfinite numbers to me and who gave me the faith and strength to defend set theory against the criticism it received.[64] I think He did this so that I might give His church the first true philosophy of the infinite[65] and reconcile the word of God with true philosophy and science, according to Pope Leo XIII's 1879 encyclical, *Aeterni Patris*.[66] To this end I corresponded with a number of high-ranking Catholic Priests such as Constantin Gutberlet, who used set theory to support his ideas about the reality of actual infinity. Other priests interested in set theory included Ignatius Jeiler, a group of Jesuits led by Thomas Esser, and even Cardinal Johannes Franzelin.[67] The cardinal condemned my work as pantheistic, but after I explained the difference between transfinite and absolute infinity, he agreed that transfinite infinities represent actual infinities that are less than God's perfect, divine infinity.[68] I even addressed a few documents directly to Pope Leo XIII himself.[69] I'm not Roman Catholic, but I was glad to help the Church understand the reality of actual infinity.

Aristotle:

Cantor, you may be right. I still hold that natural numbers are *potentially* infinite, because you can never get through them by counting—they have no end. But the number of all natural numbers can be realized; we just have to get beyond notions of counting to see it. Infinite sets actually have a well-defined size denoted by their cardinality. Your example of the line is instructive here: A finite line segment comprises an infinite number of points, which are uncountable because they're infinitely more numerous than the very numbers we use for counting! Still, we do know how many points are on the line, because we know the line is a set with cardinality $2^{\aleph_0}$. Potentials, even potential infinities, can be actualized if you use the right method. For example, we know humans can't swim across the Mediterranean. Yet on the other hand, we know people can potentially build ships and can, therefore, actually cross the sea.[70] But I'm still puzzled about Ω.

Cantor:

Transfinite numbers are definitely simpler than Ω. Some transfinite numbers are even more accessible than some natural ones. Isn't the number $\aleph_1$ easier to comprehend than, say, $12^{346,280} + 7$? This number clearly exists, but it has no practical value—ideas like ω and $\aleph_1$ are more important philosophically, theologically, and practically.[71]

Nicholas:

Well, at least we all agree about the transfinites. I'm glad you resolved the potential-actual paradox, but the resolution just proves my point that neither concept is useful for talking about God.

Aquinas:

Maybe not, but Aristotle's distinction also helps us understand the idea of limits. Infinite sets are unlimited with respect to their potential, because they can't be counted. Still, sets represent types of containers, and anything we can put into a container must be bounded. Cantor has shown that sets—even infinite ones—are limited by their cardinality. Let's go back to the line example. Every line segment has endpoints and a finite length, but it still contains $2^{\aleph_0}$ points.[72] The line is finite in one aspect, and infinite in another. As for absolute infinity, it is infinite in every aspect.[73] We know Ω can't be put into a container, so it's unlimited in a way that transfinites aren't. I might say that Ω only exists in potential if I weren't so sure that the collection of all sets is real. After all, it's hard to see how a collection of things can be less real than the things collected.

Nicholas:

Thomas, you've just explained away one more paradox—transfinite numbers are both unlimited and contained. But as the paradox disappears, so does our hope of understanding God through the language of set theory.

Aristotle:

Are you sure Ω is real?

Augustine:

Of course! Earlier I talked about the ontological gap between the finite and the infinite, but now that we know about different kinds of infinity, we can see that the gap actually separates the transfinite and the absolute infinite. The transfinite sequence of ordinal containers suggests absolute infinity, but Ω transcends set theory and all transfinite numbers. You can't count it and you can't manipulate it, even with transfinite arithmetic. The hierarchical relationship among the finite, the transfinite, and the absolute infinite can, however, help us understand our relationship to God. Observations suggest we are both part of and different from the rest of God's creation. Perhaps our relation to God's creation is analogous to the transfinite's relation to the finite. Didn't Aristotle's analogy show that humans have both potential and actual abilities? And that our minds and bodies are limited in some ways, but have limitless potential in others? Our minds are illumined by sparks of God's divinity that direct our thoughts towards God.[74] But we'll never overcome the fundamental divide—the ontological gap—between us and God. You can extend this analogy to look at God's relationship to the world. Ω contains all sets, but is not itself contained. The language of set theory points to Ω but finally cannot describe it, because it's ontologically different from everything we can describe in mathematical or set theoretical terms. Similarly, God is imminently present in the world since the whole world is encompassed by God. At the same time, God is different from physical reality and transcends all attempts at description in ordinary language.

Aristotle:

Are you saying Ω is equivalent to God?[75]

Augustine:

No, but some kind of relation exists between Ω and the divine, because the abstract notion of number comes to us by what can only be called divine inspiration.[76] Even if we were given the ability to understand Ω, we still couldn't comprehend God, of whom Ω is an incomplete, imperfect reflection. I've always believed in analogy. Nicholas might not, but if Cantor hadn't used finite numbers as an analogy for understanding the infinite, we'd still be in the dark about absolute infinity.

Nicholas:

[Triumphantly] Fair enough, Augustine, but this is really the end—I've finally found a paradox I can sink my teeth into. We understand—we *know*—Ω is real, but we've also proven it can't be a set, so we can't understand Ω in set theoretic terms. Going beyond set theory will always mean using imperfect analogies, guesswork, and faith. Humans can never lift the veil that shrouds God in unknowable majesty. Navigating through all these

paradoxes only reveals the strangest paradox of all. We've convinced ourselves we can know something about the unknowable by using language to talk about ideas that we admit defy description! Within this paradox, this mystery, we finally have some hope of encountering God.

Cantor:

Well, I think we've gone through all of infinity. I hope you enjoyed this class as much as I did. Be sure to stop by next week for Robinson's lecture on non-standard analysis!

Works cited:

Aczel, Amir D. *The Mystery of the Aleph: Mathematics, the Kabbalah, and the Search for Infinity*. New York: Four Walls Eight Windows, 2000.

Aquinas, Thomas. *Summa Theologiae*. Trans. Blackfriars. London: Eyre and Spottiswoode, 1963.

Aristotle. *Physics*. In *The Complete Works of Aristotle*, ed. by Jonathan Barnes. Bollingen Series 71. Princeton: Princeton University Press, 1984.

Augustine of Hippo. *City of God*. Trans. Philip Levine. Loeb Classic Library 414. Cambridge, Mass.: Harvard University Press, 1966.

_____. *The Trinity*. Trans. Edmund Hill. Brooklyn, N.Y.: New City Press, 1991.

_____. *The Confessions*. Maria Boulding, trans. New York: Vintage Books, 1998.

Blanchet, Louis-Emile. "Some Aspects of the Infinite." *Laval Théologique et Philosophique*. 22:1 (1966): 9-21.

Bohler, Carolyn Stahl. "Varieties of Religious Infinities." *Christian Century* 108 (16 January 1991): 38-39.

Bostock, D. "Aristotle, Zeno, and the Potential Infinite." Aristotelian Society. 73 (1972): 37-51.

Brezik, Victor B., ed. *One Hundred Years of Thomism*. Houston: Center for Thomistic Studies, 1981.

Burns, Robert M. "Divine Infinity in Thomas Aquinas: II. A Critical Analysis." *Heythorp Journal* 39 (1998): 123-39.

Cantor, Georg. *Contributions to the Founding of the Theory of Transfinite Numbers*. Trans. P. Jordain. Chicago: Open Court, 1915.

_____. "Foundations of the Theory of Manifolds." Trans. Uwe Parpart. *The Campaigner* 9 (1976): 69-96.

_____. "Letter to Dedekind." In *From Frege to Gödel*, ed. by J. van Heijenoort, 113-17. Cambridge, Mass.: Harvard University Press, 1967.

_____. "Mitteilungen zur Lehre vom Transfiniten." *Zeitschrift für Philosophie und philosophische Kritik* 91 (1887): 81-125, 252-270.

_____. "Mitteilungen zur Lehre vom Transfiniten" *Zeitschrift für Philosophie und philosophische Kritik* 92 (1888): 240-265.

_____. "Über die verschiedenen Standpunkt in Bezug auf das actuale Unendliche." *Zeitschrift für Philosophie und philosophische Kritik* 88 (1886): 225-33.

Catalano, Joseph S. "Aristotle and Cantor: On the Mathematical Infinite." *Modern Schoolman* 46:3 (March 1969): 264-67.

Charlton, William. "Aristotle's Potential Infinites." In *Aristotle's Physics: A Collection of Essays*, ed by L. Judson, 129-49. London: Oxford University Press, 1991.

Cohen, Paul J. *Set Theory and the Continuum Hypothesis*. New York: Benjamin, 1966.

Dauben, Joseph W. *Georg Cantor: His Mathematics and Philosophy of the Infinite*. Princeton: Princeton University Press. 1990.

_____. "Georg Cantor and Pope Leo XIII: Mathematics, Theology, and the Infinite."

Journal of the History of Ideas 38 (1977): 85-108.

Davies, Brian. *The Thought of Thomas Aquinas.* Oxford: Clarendon Press, 1992.

Drozdek, Adam. "In the Beginning Was the 'Apeiron': Infinity in the Presocratics." *Epistemologia* 20 (16 October 1978): 3-32.

_____. "Number and Infinity: Thomas and Cantor." *International Philosophical Quarterly* 39, no. 1 (March 1999): 35-46.

_____. "Beyond Infinity: Augustine and Cantor." *Laval Théologique et Philosophique.* 51, no. 1 (February 1995): 127-40.

Edel, Abraham. *Aristotle and His Philosophy.* Chapel Hill: University of North Carolina Press, 1982.

Enderton, Herbert B. *Elements of Set Theory.* London: Academic Press. 1977.

Gödel, Kurt. *The Consistency of the Continuum Hypothesis.* Princeton: Princeton University Press, 1940.

van Heijenoort, Jean, ed. *From Frege to Gödel.* Cambridge, Mass.: Harvard University Press, 1967.

LaMountain, George F. J. "Concept of the Infinite in the Philosophy of St. Thomas Aquinas." *The Thomist* 19 (1966): 312-38.

Lavine, Shaughan. *Understanding the Infinite.* Cambridge, Mass.: Harvard University Press. 1994.

Leo XIII. "Aeterni Patris." In *One Hundred Years of Thomism*, ed. by Victor Bezik, 173-97. Houston, Tex.: Center for Thomistic Studies, 1981.

Markus, R. A. *Signs and Meanings: World and Text in Ancient Christianity.* Liverpool: Liverpool University Press, 1996.

Meschkowski, H. "Aus den Briefbüchern Georg Cantors." *Archive for History of Exact Sciences* 2 (1965): 503-519.

Nicholas of Cusa. *On Learned Ignorance.* 2nd ed. Trans. Jasper Hopkins. Minneapolis: Arthur J. Banning Press, 1985.

_____. *De Possest. [On Actualized-Possibility.]* In *A Concise Introduction to the Philosophy of Nicholas of Cusa*, 3rd ed., by Jasper Hopkins, 64-189. Minneapolis: Arthur J. Banning Press, 1986.

Rioux, Jean W. "Cantor's Transfinite Numbers and Traditional Objections to Actual Infinity." *The Thomist* 64 (2000): 101-25.

Rucker, Rudy. *Infinity and the Mind.* Princeton: Princeton University Press, 1995.

Small, Robin. "Cantor and the Scholastics." *American Catholic Philosophical Quarterly* 66, no. 4 (1996): 407-28.

Sweeney, Eileen C. "Thomas Aquinas' Double Metaphysics of Simplicity and Infinity." *International Philosophical Quarterly* 33, no. 3 (September 1993): 297-317.

Sweeney, Leo. *Divine Infinity in Greek and Medieval Thought.* New York: Peter Lang, 1992.

Teske, Roland J. "Divine Immutability in St. Augustine." *Modern Schoolman* 63 (1986): 233-49.

_____. *Paradoxes of Time in St. Augustine.* Milwaukee: Marquette University Press, 1996.

Zermelo, E. *Gesammelte Abhandlungen mathematischen und philosophischen inhalts.* Hildesheim: Olms, 1966.

Endnotes:

1. Aristotle, III, 5, 204b, 1ff.

2. Ibid. See also Charlton.

3. Aquinas, I q. 7 art. 1 r. 3; see also Davies, pp. 38–9; and Drozdek, "Number and Infinity," pp. 35–46.

4. Aristotle, VIII, 9, 266a, 6–10. Aquinas is confusing Aristotle's ideas of eternity and infinity, which is understandable given the text.

5. On conceptions of time, see Aristotle, III, 1, 251b, 11; and 252b, 5–7. On the prime mover, see Aristotle, VIII, 6, 259a, 7ff; and 260a, 17–19.

6. These are my terms, but cf. Augustine, *Confessions*, VII, 20, 26; quoted in Teske, "Divine Immutability," p. 247.

7. Nicholas of Cusa, *De Possest*, 11.

8. Aquinas, I q. 7 art. 1.1. In his works, Aquinas concomitantly maintains two senses of infinity; one "names the completely determined or perfect, the other stands for the radically indeterminate" (quoted in Eileen C. Sweeney, p. 305); see also LaMountain, pp. 312–38.

9. Aristotle, III, 5, 204a, 15ff.

10. Nicholas of Cusa, *On Learned Ignorance*, II–1.

11. Drozdek, "Beyond Infinity," p. 128-30.

12. Aristotle, III, 6, 207a, 16–31.

13. Aquinas, I q. 7 art. 1.1.

14. Nicholas of Cusa, *On Learned Ignorance*, I–3, 17; cf. *De Possest*, 19.

15. Aristotle, III, 6, 206b, 1ff. See also Charlton, pp. 135–142.

16. Aristotle, III, 4, 203b, 15ff; III, 6, 206a, 19–34; see also Edel, pp. 76–88.

17. God as actualized potentiality is the central theme of *De Possest*; see Nicholas of Cusa, *De Possest*, 7–8, 14.

18. Drozdek, op. cit., pp. 130–31; on Augustine's concept of analogy, see Markus, ch. 1 and 3.

19. Nicholas of Cusa, *On Learned Ignorance*, I–26.

20. Drozdek, op. cit., pp. 128–30.

21. Nicholas of Cusa, *De Possest*, 43, 62–3; *On Learned Ignorance*, II–1, 4.

22. Aristotle, VIII, 10.

23. For examples of Augustine's paradox-resolving, see Teske, *Paradoxes of Time*.

24. Aristotle, VIII, 8, 263a, 4ff; see also Edel, pp. 76–78; and Bostock.

25. Nicholas of Cusa, *De Possest*, 11; Nicholas writes, "*Non est vocabulis insistendum* [We must not insist upon the words]."

26. Davies, pp. 60–62.

27. Nicholas of Cusa, *On Learned Ignorance*, I–26; cf. I–3.

28. Nicholas of Cusa, *On Learned Ignorance*, I–10; see also *De Possest*, 15, 41.

29. Teske, *Paradoxes of Time*, pp. 31–2; and Markus, pp. 84–5; cf. Drozdek, "Beyond Infinity," pp. 130–31.

30. Cf. Aristotle, III, 1, 200b, 33ff.

31. Nicholas of Cusa, *On Learned Ignorance*, I–16, I–17.

32. I.e., the square root of 2 is an irrational number.

33. Nicholas of Cusa, *De Possest*, 42–43.

34. On the modern problem of what it means to understand infinity, see Blanchet.

35. For a review of pre-Aristotelian Greek thought on infinity, see Drozdek, "In the Beginning Was the 'Apeiron.'"

36. The following introduction to set theory owes much to Rucker's book, esp. pp. 36–48, 57–78, 238–53. For a concise formal introduction to set theory, see Enderton. For Cantor's formulation of set theory, see Cantor, "Foundations of a General Theory of Manifolds." This and most of Cantor's published works are collected by Zermelo in *Gesammelte Abhandlungen mathematischen und philosophischen inhalts*.

37. These definitions assume the existence of the first ordinal.

38. For Cantor's notion of ordinal, see Cantor, "Theory of Manifolds," pp. 71–74; and Cantor, *Contributions to the Founding of the Theory of Transfinite Numbers*, pp. 111–118. For a modern interpretation, see Lavine, pp. 80–85.

39. It is unclear whether Cantor viewed ordinals themselves as sets; see Lavine, p. 79.

40. The natural numbers (or counting numbers) make up the sequence $\{1, 2, 3\ldots\}$ or $\{\mathbb{1}, \mathbb{2}, \mathbb{3}\ldots\}$.

41. Omega, the last letter in the Greek alphabet. ω superseded ∞, the classical symbol for infinity.

42. "There is an ordinal number ω such that $0 < \omega$; for every ordinal number α, if $\alpha < \omega$, then $\alpha + 1 < \omega$; and for every nonzero or-

dinal number $\alpha < \omega$ there is an ordinal number β such that $\alpha = \beta + 1$" (Lavine, p. 80).

43. To distinguish them from their finite analogues, the symbols $\oplus$ and $\otimes$ will be used for transfinite addition and multiplication, respectively.

44. Aristotle and Cantor had slightly different notions of what exactly constituted potential and actual infinity, so it is difficult for them to argue without misunderstanding one another. See Catalano; Rioux.

45. Lavine, pp. 44–46, 96–98; Cantor's theory of powers prefigured development of cardinal theory, which in later years gained greater importance in his set theory; see Cantor, *Contributions to the Founding*, pp. 85–97.

46. This is a variant of Galileo's Paradox; see Aczel, pp. 51–56.

47. Cf. Hilbert's Hotel analogy in Rucker, pp. 73–77.

48. The first letter in the Hebrew alphabet, pronounced "aleph."

49. Georg Cantor, *Contributions to the Founding*, pp. 103–10.

50. Rucker, pp. 75–78.

51. For a concise overview of the historical development of the continuum hypothesis, see Lavine, pp. 42–102; and Dauben, *Georg Cantor*, pp. 30–94. The mathematical investigations of the continuum that led Cantor to develop transfinite set theory are summarized in Dauben, *Georg Cantor*, pp. 37–66.

52. In fact, Cantor also showed that the cardinality of the number line is equal to the cardinality of any n-dimensional space such as a plane or volume; see Dauben, *Georg Cantor*, pp. 50–58. For Cantor's 1874 proof, see Lavine, pp. 42ff; and Dauben, *Georg Cantor*, pp. 47–54. A review of Cantor's better known diagonal theorem can be found in Rucker, pp. 235–38.

53. Here S represents the cardinality of the set S.

54. Cantor, *Contributions to the Founding*, pp. 94–97; for a modern interpretation see Rucker, pp. 238–53.

55. Ie., $\mathcal{P}N = 2^{\aleph_0}$.

56. For Cantor's struggle with the continuum, see Rucker, pp. 221–53, and references here in note 51. The proof that the Continuum Hypothesis cannot be disproved was completed by Kurt Gödel in 1938; see Gödel. The proof that the Continuum Hypothesis cannot be proved was completed by Paul J. Cohen in 1963; see Cohen.

57. Uppercase omega.

58. Sometimes called Russell's Paradox, after Bertrand Russell.

59. Lavine, pp. 63–65, 76–79.

60. Cantor, letter to Dedekind, dated 28 July 1899, in van Heijenoort, pp. 113–117.

61. Cantor, "Theory of Manifolds," p. 76.

62. The Reflection Principle formally states that Ω is beyond complete comprehension; see Rucker, pp. 50–51, 80–81, 255–60.

63. See Dauben, *Georg Cantor*, pp. 125–26.

64. Ibid., pp. 294–97.

65. Dauben, "Georg Cantor and Pope Leo XIII," p. 107. This article closely follows the contents of chapter six in Dauben's book, *Georg Cantor*.

66. Leo XIII's encyclical of 4 August 1879, called for the reconciliation of the church with true science and philosophy, largely through renewed study of Aquinas (ie., Neo-Thomism or Neo-Scholasticism). For an English translation, see Brezik, pp. 173–197.

67. Small, pp. 418–27. Cantor's correspondence with these theologians was published in *Zeitschrift für Philosophie und philosophische Kritik*, vols. 88, 91, 92, and reprinted in Zermelo, pp. 370–439; see also Meschkowski.

68. See Dauben, *Georg Cantor*, pp. 144–46; and Zermelo, pp. 375, 385–87, 399–400.

69. This comment is based upon an unsubstantiated claim in Dauben, "Cantor and Pope Leo XIII", p. 85.

70. For a related argument, see Bohler.

71. Rucker, p. 235; cf. Cantor, "Foundations of the Theory of Manifolds," p. 79.

72. Cf. Aquinas, I q. 7 art. 4 reply.

73. Ibid., I q. 7 art. 3 reply.

74. Augustine, *De Trinitate* XIV, 21; cf. Drozdek, "Beyond Infinity," pp. 130–31.

75. This is a common misreading of Cantor's theological position, promulgated, for example, in Aczel, p. 132.

76. Augustine, *City of God,* XII, 19.

Stephen Henry grew up in Natchitoches, Louisiana, and received a bachelor's degree in chemistry from Harvard University in June, 2000. As an undergraduate, his involvement at the Harvard Episcopal Chaplaincy sparked an interest in theology. He was awarded the Harlech Scholarship for 2000-2001, which provided funds for a year of unrestricted study at New College, Oxford. He spent this year studying science and religion, during which time he wrote this essay with the supervision of the Reverend Dr. Robert G. Harnish.

Stephen will matriculate at Vanderbilt Medical School in the fall of 2001 and plans to make theological study a lifelong pursuit.

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F&SE

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- to study and resolve historical misunderstandings between the scientific and religious communities; and
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Editors' Note: As a matter of editorial policy, gender-inclusive language has been used throughout. Exceptions are made for reasons of historical accuracy and for the treatment of gender-specific matters. Scripture quotations, but not quotations from other source material, have been modified accordingly.

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with a foreword by
Gail Phillips Bucher, M.S.

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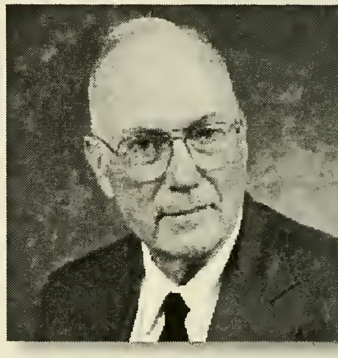

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Foreword

Gail Phillips Bucher, M.S.

Director, New England Center for Faith and Science Exchange
Administrator for the Certificate Program in Science and Religion, Boston Theological Institute
Managing Editor

What a difference a year makes! As we went to press with Volume IV of *The Journal of Faith and Science Exchange* in late summer 2001, President George Bush was trying to decide whether or not the federal government should fund stem cell research. After much consternation, he reluctantly approved limited stem cell research using existing stem cell lines.

September 11 and its horrific events were yet to occur; the possibility of human cloning and stem cell research without embryonic cells were yet to be announced; the unprecedented joint declaration of Pope John Paul II and Ecumenical Patriarch Bartholomew I stating that protection of the environment is a "moral and spiritual" duty was in the future; Intelligent Design had not yet been mandated by some school boards; announcements of the discovery of eleven additional moons of Jupiter would come later; and the world—especially the science-and-religion field—had not yet lost one of its finest sparring partners, Stephen J. Gould.

Many of the above-mentioned events have implications for the field of science and religion, as well as for the greater society. In reflecting on these events, there are many advances and other issues that affect us as part of the human family. Scientific and technological progress raises new moral and ethical concerns. The events of September 11 show the power of hate and the vulnerability of even the strongest nations. Thousands of innocent people were killed; but in the aftermath, many were also wrongly accused because of their religious faith. Many faith communities took the opportunity to learn more about Islam and about the rich heritage that it has given to science and society. In this volume, Dr. Muzaffar Iqbal, the 2001 F&SE Spring Lecturer, discusses this rich heritage in his paper.

Volume V of the *Journal* includes papers and essays of several types: student essays from the Publishing Prize Competition, invited and contributed papers from the 2001 Science and Religion Colloquium, a presentation from the F&SE Lecture Series, and integration papers from students in the Boston Theological Institute's Science and Religion Certificate Program. While not specifically planned, several of these papers raise issues that are in some way related to the events of the past year.

Protecting the environment has been one of many goals in the science and religion field for several years. The joint declaration by two of the most powerful and influential religious leaders in world was a milestone in environmental responsibility. Speakers at the 2001 Science and Religion Colloquium addressed the topic of water, from various and religious and scientific perspectives. As we know, in many part of the world, water—especially clean water—is no longer a plentiful commodity. Some economists fear that future wars may be fought over water, rather than oil. Protecting, cleaning up, and preserving water resources need to be a priority, not only for ourselves, but also for future generations. Several papers in this volume address the subject of water and other topics relating to the environment.

Biotechnology and bioethics are common subjects in science and religion. In late November 2001, Advanced Cell Technology announced that human cloning was possible. In spring of 2002, researchers at Tufts University School of Medicine and St. Elizabeth's Medical Center of Boston announced that non-embryonic stem cell research was possible. In September 2002, scientists claimed ways to preserve endangered species was through cloning of enucleated cells and taking a slice of the cell to begin the cloning process. All of these advances in scientific research and technology give rise to many questions in faith communities and the biotech industry, such that the industry has initiated discussions with faith communities. Many of the issues are complex. They can have a great impact on moral values and society, and therefore they must be addressed. During the past year, F&SE received a Local Society Initiative Grant to develop programs to educate the public in scientific and ethical issues regarding four topics: gene therapy, stem cell research, human cloning, and genetically modified foods. Two student papers in this volume address the scientific and moral issues regarding informed consent.

Intelligent Design, the Big Bang, and creationism have been introduced in the classroom in some states in the U.S. Supporting sound science in school curricula is laudable; advancing religious beliefs in the science classroom seems to be both bad science and bad religion.

Fascination with the wonders of cosmology and astronomy has continued for thousands of years. Improved technologies have enabled scientists to discover new moons, stars and other solar systems. For example, in 1610 Galileo discovered four moons of Jupiter using a telescope that he made himself. Additional moons were discovered over the years, but newer technology and equipment have helped astronomers to detect twenty-two additional moons in the past two years. Subsurface oceans on several of Jupiter's moons have convinced some scientists that these moons can support life. In viewing the heavens on a clear night, I feel the presence of the Divine and the vastness of the universe. The great expansive sky seems to remind us that, as humans in the universe, we are only a moment in its history. Yet, during that brief moment, we have become the discoverers of the cosmos and its wonders, and many more discoveries wait ahead.

As I marvel at the scientific advances of the past year and their affects on society, I am reminded of comments made recently by friends, Dr. James Skehan, S.J., and Dr. Charles Townes. They say that God does not reveal everything to us all at once. If so, there would be no wonder, curiosity, questions, research, or discovery, and we would lack a purpose in life. Fortunately, new revelations are made constantly and new questions arise from them. Wonder, curiosity, research, and discovery abound, and we do have a purpose for life. The science-and-religion dialogue seems to hold discovery and purpose in tension.

Gail Phillips Bucher was trained in pharmacy and pharmacology at Massachusetts College of Pharmacy and Northeastern University. During her thirty-five-year career in industry, she received numerous honors. She was the first woman to receive the College Medal from her alma mater, now known as Massachusetts College of Pharmacy and Health Sciences. She also received the prestigious Merit Award from the Society of Cosmetic Chemists, in which she remains active locally, nationally, and internationally. In 1996 she took early retirement in order to pursue a ministry with the poor. She trained to become a Service Deacon, and serves primarily at her home parish of University Lutheran Church in Cambridge, Massachusetts, and its shelter for the homeless.

Her interest in the interactions between science and religion led her to become a charter member of the Advisory Board of New England Center for Faith and Science Exchange (F&SE) in 1989. From 1999-2002, she served as the Director of F&SE and also as the Administrator for the Certificate Program in Science and Religion of the Boston Theological Institute. She is a member Alliance for Faith, Science, and Technology of the Evangelical Lutheran Church in America.

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Introduction

Barbara Smith-Moran, S.O.Sc.
Senior Editor

As in earlier volumes, in this year-2001 issue of *The Journal of Faith and Science Exchange*, we proudly feature some of the best work of up-and-coming scholars who work at the interface of religion and science. They hail from ten schools and programs and do their primary research in several scientific and theological fields. The fifteen papers authored by graduate students have been recommended by their faculty mentors, first of all. These mentors conprise this year's Editorial Panel. The papers were then reviewed by a internationally recognized panel of scholars beyond the Boston Theological Institute. Three of these papers were awarded Publishing Prizes as outstanding contributions to this field of inquiry.

Interleaved with these essays, we feature several papers by senior scholars: ethicist **James Nash**, physicist **Paul Carr**, neuroepidemiologist **Olaf Dammann**, science historian **Muzaffar Iqbal**, and theologians **Lucio Florio** and **Kurt Anders Richardson**.

A paper on healing and medicine by research physician **Olaf Dammann** opens this volume with a study of the healing powers of water. This is followed by three papers in the field of medical ethics written by students in the Certificate Program in Science and Religion,* **Konstantinos Symeonides**, **Judit Gellerd**, and **Makarios Griniezakis**. Using the lens of Native American religious ethics, **Stephanie St. Pierre** critiques the societal and spiritual influence of biotechnology.

Three authors contribute to the field of theological cosmology. **Cheryl Genet** examines the potential of complex-systems approaches and process thought to help produce a modernized cosmology with wide appeal. **Stephen Henry** looks at how physicist Ilya Prigogine might address some of the questions posed to physical scientists by Wolfhart Pannenberg. **Frank Villa** presents Kepler and Teilhard as models of scientist-theologians who produced scientifically-informed theological cosmologies that served well in their own historical context.

Muzaffar Iqbal gives a careful corrective to the nineteenth-century Orientalist bias found in many analyses of the contributions of Islamic scientists to the scientific corpus.

Following this historical study come five essays in the area of ecology and environmental ethics. **Paul Carr** and **Kurt Richardson** write about water's ritual and sacramental properties. **James Nash** outlines foundational moral norms for remedial action on New England's waters. **Tovis Page** makes the case that the consecration of natural sites, as Walden Pond was consecrated by Thoreau, opens the door to fresh insights in the study of religion and ecology. With a view toward equity in bearing the burdens of expected climate change, **Pablo Suarez** presents an appeal to the religious community to advocate for adaptive measures to reduce the impacts of the flood events that will, in all probability, affect the greater Boston area.

Three authors consider epistemological themes. **Gregory Maslowe** opens this section with the proposal that enactionism might be a fruitful alternative to critical realism for the science-and-religion dialogues. **Elizabeth Patton** revisits the work of nineteenth-century philosopher Charles Sanders Peirce, whose voice ought to be better known in contemporary science-and-religion discussions, in which the assurance of rigid certainty ought not be a goal. **Lynn Labs** makes the case that non-rational thought is important to both scientific and religious seekers.

* See p. 6

The environmental crisis leads **Lucio Florio** to consider the unique role of human beings in the universe—filling the role of God's vicars in Creation, rather than lords with mastery over it. **Russell Genet** explains the inadequacy of sociobiological explanations of human altruism in large groups, numbering in the thousands and millions. At a time when biotechnological advances invite constant reassessment of humanness, **Iljoon Park** suggests that the concept of "betweenness" in Confucian thought is helpful in understanding human morality in the science-and-religion context. This topic is rouded off by **Léon Turner**, who argues that the conceptualization of personhood by psychology and by theology are not so far apart, after all.

The Boston Theological Institute and the International Center for Faith and Science Exchange share a commitment to science-and-religion methods of learning about the world and about human and divine nature. Expanding the dialogues of this inquiry to include new voices, especially the voices of young scholars with innovative approaches and ideas, is the mission of the editors of *The Journal of Faith and Science Exchange*. This issue confirms our mission and builds upon a tradition of fine scholarship.

Barbara Smith-Moran, S.O.Sc., is the Founding Director of the Center for Faith and Science Exchange and of the Science and Religion Program of the Boston Theological Institute. She directed both programs until 2000, when she became the Northeast Regional Director of the Science and Religion Course Program of the Center for Theology and the Natural Sciences (Berkeley, California).

An astronomer and Episcopal priest, she is a life-professed member of the Society of Ordained Scientists, a dispersed religious order of the Anglican Church. She serves as an interim pastor in the Diocese of Massachusetts, where she also co-convenes the diocesan Faith and Genetics Working Group. At the national level of the Episcopal Church, she co-chairs the Committee on Science, Technology and Faith.

She is the author of Soul at Work: Reflections on a Spirituality of Working *(St. Mary's Press, 1997), and co-editor (with Audrey R. Chapman and Rodney L. Petersen) of* Consumption, Population, and Sustainability: Perspectives from Science and Religion *(Island Press, 2000).*

She and her husband Jim, an astronomer, live in Concord, Massachusetts. They have two grown children, Susan and Michael.

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THE HEALING POWERS OF WATER: MYTH, MECHANISM, OR METAPHOR?

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The author presents epidemiologic evidence supporting the notion of water as an important factor in disease transmission and causation. In the disease process itself, water probably plays a minor medical role, but it has major subjective importance. Secondly, he argues that water is a strong symbol for the life cycle and the process of re-creation. The meaning that water gains as a potential contributor to the healing process needs to be examined more systematically. Thirdly, his hypotheses are that water is a carrier of both therapeutic mechanism and meaning, and that the importance of mechanism to cure is secondary to the importance of meaning to healing. One reason for this might be that one of water's metaphoric facets is that it provides a symbolic link between the human and the divine.

As the rain and the snow come down
from heaven,
and do not return there until they
have watered the earth,
making it bring forth and sprout,
giving seed to the sower and bread
to the eater,
so shall my word be that goes out from
my mouth.
—Isaiah 55: 10-11

Introduction

This essay deals with the issue of water in health and sickness, in healing and, especially, in re-creation. The goal is to begin sketching, by use of examples, a framework intended for use in future research.

I begin with two brief terminologic notes. For the purpose of this paper, I would like to define "recovery" as the restoration of health from sickness. With regard to the body (however defined), I call this *cure*; with regard to the soul and mind (however defined), I call this *healing*. Thus, recovery includes both cure and healing. Obviously, I do not view body and soul/mind as separate, but as integrated entities, with aspects of the body being part of the soul/mind and *vice versa*.

When using the word "re-creation," I wish to refer to the process of creating somebody anew, somebody who had already been created some time ago, but is now detached from at least some of the results of this initial creative process, for example, by disease. I use the term to allude to the idea that there is more to re-laxation than only re-storation, namely, the process of repeating creation, of bringing something about anew.

Water in Disease and Recovery

Water plays a role in disease and recovery with regard to at least three aspects: as a determinant of disease causation, as a contributor to some of the bodily changes associated with sickness, and as a factor involved in the recovery from disease.

Water and disease causation

In the first chapter of his classic text on the history of public health, George Rosen lists the five major characteristics of community life that are related to health and disease: (1) the control of transmissible disease, (2) sanitation, (3) the provision of water and food in good quality and quantity, (4) the provision of medical care, and (5) relief of disability and destitution.[1] Water is an essential part of at least the first three, if not all five of these points.

Indeed, water has been known for millennia to play a role in disease occurrence and causation. With his essay, "On airs, waters, and places ..." (ca. 400 BCE), Hippocrates offered the first known treatise on the causal relations between environmental factors and disease. In it, he has lengthy passages on the potential health hazards associated with waters of all sorts.[2]

The rhythms of human life are often compared to the rhythms of nature, of which the rhythms of the waters are an important part; imagine the emotional appeal of the rich imagery of the tides going back and forth, the sunshine and rain coming and going, the drying-up and refilling of rivers with the changing seasons

A more recent story that is part of every introductory course in modern epidemiology is that related by John Snow (1813-1858), who linked the number of deaths in specific quarters of London during the 1854 cholera epidemic to the location of water uptake from the River Thames.[3] Snow thereby identified the source of the disease by correctly interpreting the observation that more deaths occurred in households supplied with water from the lower Thames than in those whose water came from the upper Thames. He suggested that a living organism was transmitted by water from the excrements of the diseased through the alimentary tracts of the healthy. It remains unclear if the disease outbreak had already came to its end before or only after Snow had removed the handle from the public water pump on London's Broad Street. Of note, all this happened fully thirty years before Robert Koch isolated *Vibrio cholerae*, offering support for Snow's theory.

Roles for water in disease

Our bodies consist of water—at least, in large part. Therefore, fluid imbalances play an important role in health and disease. Extremes are increased water loss (dehydration) and overload (hyperhydration; or in tissue, edema). Both bring dramatic changes in the constitution of the diseased body, which—above and beyond the limitations to body function during disease—further contribute to the changes in body appearance, thereby affecting a person's self-perception when sick. Apparently, water imbalances are very important subjectively and in pathogenesis but probably play a minor medical role, since they are therapeutically often rather easily dealt with.

Water in healing and re-creation

Of utmost importance in the context of this conference is that water can be an integral part of recovery, the process of healing and cure. Hippocrates, for example, has the following words on the contribution of water towards health:

> Whoever wishes to drink the most suitable for any disease, may accomplish his purpose by attending to the following directions: To persons whose bellies are hard and easily burnt up, the sweetest, the lightest, and the most limpid waters will be proper; but those persons whose bellies are soft, loose, and pituitous, should choose the hardest, those kinds that are most crude, and the saltiest... ; for such waters as are adapted for boiling, and are of a very solvent nature, naturally loosen readily and melt down the bowels; but such as are intractable, hard, and by no means proper for boiling, these rather bind and dry up the bowels.[4]

However one wishes to translate this kind of advice into postmodern biomedical lingo, it clearly shows that water was considered a potent health adjuvant even millennia before our time. The washing of the sick body to maintain hygiene and to prevent further damage, the nurse documenting patients' water intake and output to assure maintenance of its equilibrium, the wet tissue on the forehead to cool the feverish—these are examples of the various roles that water plays in the care for the sick.

Before I offer additional reflections, let me briefly examine whether there are good data supporting the claim that water heals. Historically, balneotherapy had its place in medicine, including the use of fountains and baths, Father Kneipp's water cure,[5] and the consumption of mineral water as a health drink. The current interest in so-called "alternative" therapies that flourish in response to what some consider the arrogance of modern biomedicine also covers balneo- and hydrotherapy.

On at least two levels, an increased usage of water in medical and physio-therapy can be observed. First, consider the growing public interest in spa activities, a symbol of both health and wealth, since it shows not only that one is aware of the necessity to take good care of oneself, but also that one has the financial and time resources to use the spa on a regular basis. Second, the flood of current health care and self-help literature includes titles such as "Healing waters" [6] and "The healing energies of water." [7] Unfortunately, what most of them have in common is a surprisingly poor quality regarding scientific method in support of the claims made in these pages. Apparently, the authors' goal is to appeal to their consumers' own subjective experiences, their personal memories, how they previously responded to the undoubtedly relaxing qualities of water-related health practices. But even strong subjective agreement should not replace a formal test of therapeutic efficacy acording to current scientific standards. The current epidemiologic paradigm is to compare groups of individuals with regard to objective characteristics, while poor-quality studies often rely entirely upon uncontrolled case series of interventions and reports of subjective experiences.

But even in the medico-scientific literature, the quality of published studies is often not as good as one would hope. Arianne Verhagen and colleagues recently summarized their conclusions based on ten randomized controlled trials designed to test the efficacy of balneotherapy in arthritis patients:

> One cannot ignore the positive findings reported in most trials. However the scientific evidence is weak because of the poor methodological quality, the absence of adequate statistical analysis, and the absence, for the patient, of most essential outcome measures (pain, quality of life). Therefore, the noted 'positive findings' should be viewed with caution.[8]

Another example is a recent study from Austria, reporting a significant decrease in blood pressure among individuals with initially medium-to-high blood pressure measurements, but no changes among those with low initial values. [9] Obviously, water may have measurable effects on symptoms, but whether it also has effects on the underlying disease remains to be shown.

There are no scientific barriers whatsoever that prevent the investigation of the effects of balneotherapy on diseases, using valid up-to-date study designs. In other words, there are no barriers to prevent bringing together current epidemiologic ("hard") method and alternative/spiritual ("soft") variables. Indeed, there is much need and a lot of room for such research.

Meaning through Metaphor

I would now like to offer the hypothesis that the following two-level metaphor or symbolism contributes to water's important meaning in the medical context: First, water as a general concept is a symbol for the human life-cycle embedded in nature. Second, water as a particular substance stands for continued re-creation.

Life-cycle embedded in nature

The following images may serve as illustrations supporting the first of the two suggested metaphors, "water is life":

• some strongly believe that human beings (phylogenetically speaking) came out of the water, i.e. , the human species developed from marine ancestors;

• at birth, our mothers' waters break; we are expelled from the amniotic fluid in the darkness of the womb into this world of air and light, making an ontogenic transition from an aquatic to an aerobic environment;

• the use of water for cleansing in rituals and other practices, such as for baptism as initiates enter the Christian community, and its use in other rites of passage, and the regularly repeated immersions in water to clean the body (and other beloved things in our lives) to maintain and protect us;

• the rhythms of human life are often compared to the rhythms of nature, of which the rhythms of the waters are an important part; imagine the emotional appeal of the rich imagery of the tides going back and forth, the sunshine and rain coming and going, the drying-up and re-filling of rivers with the changing seasons;

• the maintenance of bodily functions relies heavily on the uptake and release of water, another rhythm, where the water quite literally transcends our selves, flows through us, carrying with it what is not needed, cleaning us from the inside;

• the realization, even when we pause, stand still, do not move, that we are composed (in large part) of water; and last, but not least,

• the dissolving and decomposition of our bodies after death in graves only a few feet under the grass, readily accessible to the rainwater from above, which finally carries our selves to the deep, dark (ground-) waters of the womb of mother earth.[10] (Burials at sea represent an even more direct return of the body to the waters that connect all the ends of earth.)

It is this continuing relationship that makes water a constant companion for ourselves and a symbol for the full circle of our lives.

Re-creation

Based on this symbolism, I further hypothesize that at least some aspects inherent to water can be viewed as a symbol for re-creation. By appreciating water, for example in balneotherapy, we re-create ourselves...

• from the phylogenetic perspective, as if we re-live the transition from fish to man;

• from the ontogenetic perspective, as if we re-live the transition from the amniotic fluid to the world outside the womb;

• from a religious perspective, as water was a primary substance, apparently almost prerequisite for all creation (for example, the first chapter of Genesis teaches that the spirit of God was moving over the face of the waters before any other order was introduced to the world); and

• from the scientific perspective: hydrogen and oxygen atoms are probably among the more important atoms when it comes to the creation, sustaining, and development of any life.

Healing through meaning

I would like to offer the concluding speculation that the previously discussed two-level symbolic or metaphorical framework has the potential to re-unify individuals with their lives, to re-create them, and bring about healing, so nicely defined by [theologian?] John Pilch as the "restoration of meaning to life." [11] What qualities of water would support this speculation? Let me suggest that it is not individual qualities, but *dyads of qualities* that symbolically unify human and divine characteristics in one substance. Consider the following observations:

• water is clearly present, but somehow ungraspable to our hands;

• water is exactly measurable in smaller quantities, but somewhat immeasurable at large;

• water can be solid or fluid, and as a vapor, totally invisible;

• water is hard, but can be soft;

• water can take life, but it also sustains life, gives life;

• water can give rise to complete darkness, but it is also, at times, completely transparent.

In sum, based on its spectrum of characteristics, water can be viewed as a strong symbolic link between the human and the divine, by incorporating qualities attributed to both realms. As such, it is related to the re-creation of healthy human beings in water-related health practices, such as balneotherapy. This view offers one explanation for water's potential contribution to healing via metaphor or symbolism, above and beyond its contributions to bodily cure. This theoretical framework might be helpful in future research on the role of water in healing and cure.

Works cited:

Ekmekcioglu, C., G. Strauss-Blasche, J. Feyertag, N. Klammer, and W. Marktl. The Effect of baineotherapy on Ambulatory Blood Pressure. *Alternative Therapies in Health and Medicine* 2000 6 no. 6 (November 2000): 46-53.

Hippocrates. *On Airs, Waters, and Places.*

Keegan, Lynn, and Gerald Keegan. *Healing Waters: The Miraculous Health Benefits of Earth's Most Essential Resource.* New York: Berkley Books, 1998.

Kneipp, Sebastian. *The Kneipp Cure.* New York: Kneipp Cure Publishing Co., 1896.

Pilch, John J. *Healing in the New Testament.* Minneapolis: Augsburg Fortress Press, 1999.

Rosen, George. *A History of Public Health.* Baltimore: Johns Hopkins University Press, 1993 [1958].

Ryrie, Charlie. *The Healing Energies of Water.* Boston: Journey Editions, 1999.

Verhagen, Arianne P, H. C. W. de Vet, R. A. de Bie, A. G. H. Kessels, M. Boers, and P. G. Knipschild "Balneotherapy for Rheumatoid Arthritis and Osteoarthritis." The Cochrane Database of Systematic Reviews 4 (2002) [a medical research review database, published on the internet for subscribers].

Endnotes:

1. Rosen, p. 1.
2. Hippocrates.
3. see Rosen, pp. 261-64.
4. Hippocrates, section 7.
5. Kneipp.
6. Keegan and Keegan.
7. Ryrie.
8. Verhagen et al.
9. Ekmekcioglu et al.
10. In today's developed countries, however, environmental protection agencies make strong efforts to prevent exactly this, i. e. , the contamination of groundwater with organic substances from buried bodies (I thank ethicist James Nash for this point). However, these efforts can, in turn, be viewed as another symbolism, namely, for our anxiety to complete the life-cycle as a symptom of today's neglect of death as part of life.
11. Pilch, p. 141.

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The Hypostasis of the Logos and Informed Consent

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In the field of bioethics, freedom and autonomy assume the ability of self-regulation and determination. If one has the ability to make one's own decisions, then one represents an autonomous and free person. Such a view of autonomy faces many difficulties, because it ultimately limits those who can be considered autonomous. The Orthodox theology of the one Hypostasis of Jesus Christ presents an alternative to such a notions of autonomy, freedom and personhood. A person can be said to possess freedom and autonomy not when she or he can make decisions for herself or himself, but when she or he is perfected in Christ. When people begin to live in communion with one another and with God, their freedom increases. In this essay, the author introduces the Orthodox theology of the two natures of Christ, united to the Divine Hypostasis of the Logos at the moment of the Incarnation, and its implications for human freedom and autonomy.

Introduction

Few events in the history of the world have had as much impact on society as the Incarnation of the Logos. The Incarnation represents the greatest sign of love that God has for the entire creation. The Logos of God, by personalizing human nature in Hypostasis, offers to each human being the opportunity to regain that once lost in the Garden of Eden. The Incarnation of the Logos and the Hypostatic union can also serve as tools for the informed consent process. A close look at the Hypostasis of the divine Logos and the relationship between the human and divine natures of Christ reveals an understanding of freedom and personhood not commonly held. This essay attempts to reveal this ontological perception of freedom/personhood and apply and compare it to informed consent in the realm of contemporary bioethics.

The Hypostasis of the Pre-Eternal Logos

Although Chalcedon offered the world a detailed understanding of the Person of Christ, Christology did not end in 451. The Fourth Ecumenical Council expressed the union of the two natures into one hypostasis, but it did not address how these two natures of Christ—human and divine—relate to one another in the one Person/Hypostasis of Jesus Christ. The Fifth Ecumenical Council held in Constantinople (553) dealt with this issue. The Fathers of this council state:

> The Word of God is united with the flesh hypostatically, and that therefore there is but one hypostasis or only one Person, and the holy Council of Chalcedon has professed in this sense the one Person of our Lord Jesus Christ.[1]

In his treatise of the Orthodox faith, Saint John of Damascus reaffirms and clarifies this.

> The divine hypostasis of God the Word existed before all else and is without time and eternal...and in an incomprehensible manner known only to Himself, [caused] the flesh derived from the holy Virgin to subsist in the very hypostasis that was before all the ages...and the hypostasis of the Word, which was formerly simple, became compound, yea compounded of two perfect natures, divinity and humanity.[2]

The Church Fathers hold that one cannot come to an understanding of the human nature of Christ apart from the pre-existing Hypostasis/Person of the Logos. This claim on the part of Orthodox theology results in comprehending the one Hypostasis as only divine. This of course does not prevent the Logos from actively taking human nature onto the Hypostasis. This assertion does not suggest that Christ could not be fully human, but rather it reaffirms the patristic view that the characteristic of natural humanity attains its potential when human nature exists in a theocentric reality.

Also, the decision of the Fifth Ecumenical Council reveals another important consequence. Claiming that the Divine Logos acquires human nature implies that the human nature does not become a part of another human hypostasis—the human nature of Jesus Christ does not find its personalization in another person but in the Logos. Human nature, which the Logos takes, obtains its subsistence from the Hypostasis of the Logos and should not be considered as *anhypostatic*—existing on its own.[3] John Meyendorff concludes:

> Hypostasis is the personal, "acting" *source* of natural life; but it is not "nature", or life itself.[4]

The Church never conceives of either the human nature or the divine nature of Jesus Christ as existing apart from the actual Person/Hypostasis of the Logos. Yannaras makes this point absolutely clear in his *Elements of Faith*:

> God is God since He is a Person, that is, since his Existence does not depend on anything, not even his Nature or Essence. As a Person—that is freely—He constitutes His essence or Nature, it is not His Nature or Essence which makes His Existence obligatory.[5]

This intricate doctrine of the anhypostasis of Christ's human nature gives rise to questions regarding Christ's freedom and will. If Christ's human nature exists only when connected to the divine Second Person of the Trinity, then does Christ truly possess free will? Orthodox theology understands Christ's human freedom and free will again in the context of the divine Hypostasis. By uniting human and divine nature in Hypostasis, in turn, Christ's human nature in actuality transcends all earthly limitations. John Zizioulas argues that one's personhood takes shape by the relationships that she or he makes. The stronger relationships in life usually take precedence and, thus, shape who one is as an individual. The same can be said about Jesus Christ. Because Jesus Christ's Hypostasis/Person continues to be that of the divine Logos, the relationship of the Son to the Father never ceases, but instead constitutes the person-hood of Jesus Christ.

Because each person has the right freely to determine what procedures she or he will undergo, each physician then should also have the right freely to choose not to follow through with the patient's demands if they conflict with his or her own autonomy.

Therefore, the Sixth Ecumenical Council held in Constantinople (681) correctly stated:

> It was necessary that the will of the flesh move itself, but also that is be submitted to the divine will.... For just as His most Holy and immaculate flesh, animated by His soul, has not been destroyed by being divinised but remained in its own state and kind, so also His human will has not been destroyed by being divinised. It has been rather preserved.[6]

This council teaches the presence of two wills in Christ; it also teaches that the human will submits to the divine will. This precedence given to the divine will does not attenuate humanity. Rather, it signifies the ultimate fulfillment of humanity, since Orthodoxy identifies true and authentic humanity as union and participation with God. The entire human race has, because of Christ's Incarnation, been given the possibility of union to the Godhead. Thus, the divine Hypostasis of Jesus Christ serves as a witness and as an example for all of humanity. In Jesus Christ, one observes how the human person can once again turn his or her face to God.

Bioethics and Informed Consent

Autonomy

Informed consent has become a growing issue in today's medical and scientific fields. Whereas the cloning of human beings and the creation of organs from stem cells still find themselves in the theoretical stage of their development, informed consent can be said to represent bioethics in practice. Informed consent not only appears in the discussions of institutional review boards (IRBs), but it has also made its way into the everyday lives of all human beings. Each time a person enters the hospital, a consent form must be completed. before any treatment or research can begin, the physicians and scientists must make sure that the person seeking aid places his or her signature on the bottom of the consent form.

One cannot begin to speak about informed consent without first referring to the concept of autonomy. Rarely will one read an article on informed consÖnt without coming acíoss this concept. Faden, King, and Beauchamp acknowledge this reality when they write, "Autonomy is the most frequently mentioned moral principle in the literature on informed consent." [7] Autonomy has come to imply the right of "self-determination, self-rule, and individual choice." [8] This means that each individual has the right to accept or reject treatment if she or he feels that it will be harmful, regardless of potential for this treatment ultimately to have a beneficial outcome. As each person has the right to be an autonomous agent, it can be argued that physicians and researchers have a *duty* to protect and respect the autonomy of each person who steps into the hospital or the laboratory. Because people seek medical aid when they are in a highly vulnerable state, many believe that only when they give up their autonomy will they receive better treatment. Physicians must do everything in their power to protect and maintain the ailing person's autonomy by making them active participants in their therapy.

A problem arises when one considers that physicians and researchers also have the right of autonomy and self-determination. Since respecting autonomy ultimately implies that each individual has the right to choose and accept those actions that meet their standards of beneficence, Joel James Shuman analyzes the conflict that may arise between what a patient views as beneficial and what a physician understands as beneficent action. He writes:

> My caregiver is under no obligation to provide me with the services I want if those services are not consistent with *her* understanding of what constitutes nonmaleficent/beneficent treatment; she is also an autonomous agent whose autonomy must be respected.[9]

Because each person has the right freely to determine what procedures she or he will undergo, each physician then should also have the right freely to choose not to follow through with the patient's demands if they conflict with his or her own autonomy.

Competency

Informed consent also attempts to promote and protect an individual's autonomy by moving beyond the mere collection of a signature. As Wendler and Rackoff point out, there are countless instances when "individuals are perfectly willing to sign, but unable to do so." [10] Those who concern themselves with the informed consent of patients turn their attention to one's competency. Competency can be separated into two categories — general and specific. As Stephen B. Billick writes:

> [G]eneral competency is determined by the ability to handle all of one's affairs in an adequate manner. Specific competency is defined only in relation to a specific act.[11]

When informed consent is required, physicians should look for signs of specific competency in their patients because "a patient may be unable to tell you what day of the week it is and yet be perfectly capable of understanding why they need to have their broken arm repaired."[12]

A physician may be able to determine incompetency in cases of infants, young children, and severely retarded people, because they do not exhibit signs of complex cognitive processing. In such situations, the physician cannot obtain true informed consent from these individuals and must look to acquire consent from a person legally entrusted with the care of the patient. At the same time, though, such self-evident cases do not always present themselves to the physician. Children, especially teenagers, represent a group of individuals who often clearly show signs of general competency but may not always express the specific competency needed to understand the therapy process and its consequences. The same can also be said about the elderly.

Further difficulties present themselves when one uses competency as a factor for determining whether an individual can be considered an autonomous agent who can freely choose to undergo a medical procedure or to refuse it. With so much weight given to competency and to cognitive ability, there is a risk of compromising or even abolishing individual autonomy, central in the study of informed consent.[13] No one denies the fact that people ought to be able cognitively to understand the medical procedure and the available alternatives; but when they do not possess the specific competency to do this, should they be denied the right to make decisions for themselves? By understanding children as incompetent to register specific medical information, physicians and the law refuse to acknowledge them as autonomous agents. J. D. Baum and J. P. H. Shield, from their studies on child health, do not agree with such an understanding of competency because often "the child may have a more stable and balanced viewpoint than either parent."[14] Similarly, when an adult in fact possesses "specific" competency yet begins to suffer from a disease that limits his or her brain function such that information cannot be processed in the same manner as before, society claims that this person no longer possesses autonomous qualities. Since competency has so much to do with specific cognitive functions, people who have not yet attained such faculty or who have regressed in their brain functions are denied the right to act as autonomous agents.

It must be said that Orthodox Christianity does not understand autonomy and freedom in the same sense as contemporary bioethics. The Church's attention is directed to Jesus Christ and the Holy Trinity as the models for autonomous living for all human beings.

Comprehension

The comprehensiveness of consent forms introduces another aspect of the informed consent issue. For a physician to be able to pronounce a patient competent to make highly complicated and important decisions regarding his/her well-being, the information that hospitals and research groups present to the patient must be clear and intelligible. The forms that explain the medical procedures, their side effects, and alternatives, must be written at the comprehension level of the patient. Giving vital information to people loses its meaning and significance when they have no way of understanding it.

The intricate language of many consent forms reflects the highly bureaucratic nature of the medical field. Also, because of medical malpractice litigation, the consent process has transformed into a means of legally protecting the medical institutions and the companies that sponsor research. Mark Hochhauser concludes that, as a result of the present condition of medicine and research, "consent form language (especially when dealing with 'compensation') is often full of 'legalese.'"[15] Many people do not have the knowledge to understand this type of language and, as a result, consent to procedures without comprehending what they entail. Once again, by consenting to a procedure without proper information and its comprehension, a person does not act as a fully autonomous agent, but rather as a prisoner of his or her own ignorance.

As recently as 1998, President Bill Clinton signed a "Presidential Memorandum on Plain Language," which called for all government organizations to use "plain" language in all of their new documents written after 1 October 1998, and to complete the rewriting of older documents in a more understandable language by 1 January 2002.[16] Although this signifies a step in the right direction, one must be aware of the fact that not everyone living in the United States speaks English. Therefore, even greater sensitivity to the comprehension issue is called for: consent forms must also seek to meet the needs of those who do not speak English.

Besides the complexity of the language that consent forms employ, the lack of experience with the consent process on the part of the physicians and researchers greatly decreases the comprehension of the patients. In a survey given to 144 resident physicians from three different hospitals, fewer than half of those who answered the survey recalled a course or seminar on informed consent.[17] Because so many physicians received insufficient training in informed consent, they often fail to communicate the risks and alternatives involved in the treatment they prescribe. Such poor communication lowers a patient's level of comprehension and the level of competency of the patient, thereby limiting his or her autonomy and self-regulation.

Bioethicists, to help eliminate this problem from hospitals, have devised other means of communicating necessary information. Among the newer innovations, video presentations are used to convey indispensable information and explanations of the medical procedure at hand. Patricia Agre and Kathleen McKee's survey of 204 patients and 102 of their family members reveals astounding results and hope for the future. After being shown a video that teaches important information about colonoscopy—a procedure that each patient needed—95% of the patients and 98% of the family members believed that the video presented the information in a clear and comprehensible manner. Although the results of this survey offer hope for the effectiveness of such educational techniques, the real potential for informed consent lies in the likelihood that "the addition of the videotape [to the process leading to informed consent] may have benefit in preparing patients to have a meaningful dialogue with their physician."[18]

Orthodoxy and Informed Consent

The Greek Orthodox Church does not yet have any position or formal teaching on informed consent, but it does possess an understanding of human nature founded on "the revelation of the truth about God."[19] With this in hand, it becomes feasible to formulate a response to the modern approach to informed consent. First, it must be said that Orthodox Christianity does not understand autonomy and freedom in the same sense as contemporary bioethics. The Church's attention is directed to Jesus Christ and the Holy Trinity as the models for autonomous living for all human beings. As stated earlier, Jesus Christ has human free will, expressed not only in individual choices according to personal preference, but also in allowing his will *naturally* to follow His Father's. This does not prevent Christ from being a free human person. Rather, it points to the fact that only when one no longer can make decisions as isolated individuals does one start to live autonomously. As Hierotheos Vlachos states:

> The "gnomic will," that is to say the possibility of choice, is an indication of the imperfection of man's nature. Therefore man cannot have absolute freedom. Only God has freedom in the absolute sense of the word, since God is uncreated.[20]

One should not take this statement to suggest that only when a person becomes a mindless slave does she or he acquire ultimate autonomy. Instead, the mere fact that a person has the opportunity to choose between God's natural will and his or her own will points to the reality of human imperfection. St. Paul describes this imperfect state:

> In my members another law is at war with the law of my mind, making me captive to the law of sin that dwells in my members (Rom 7:23).

The Incarnation of the Logos serves to help human beings overcome this struggle. Each person overcomes his or her own desires and moves to do that which once came naturally, when she or he becomes a living member of the Body of Christ. Baptism offers all people membership to Christ's life-giving Body. As St. Paul writes, "As many of you as were baptized into Christ have clothed yourselves with Christ" (Galatians 3:27). He continues this point: "For in the one Spirit we were all baptized into one body—Jews or Greeks, slaves or free—and we were all made to drink of one Spirit" (1 Corinthians 12:13).

The relationship formed between the physician and the patient should not try to emulate that between a student and a professor in the lecture hall. Instead, this relationship ought to strive to imitate the manner in which God exists.

The dialogue model that Patricia Agre puts forth would help provoke both patient and doctor into living lives in Christ. In order for any dialogue to take place—meaningful dialogue, that is—one must consider informed consent, not as a single event or moment in the therapy process, but as an actual process itself.[21] When viewed in this way, not only does the patient feel more assured that she or he will receive greater quality of care and information, but something much deeper takes place. Constance Baker writes that by understanding informed consent as a process,

> The interchange [between patient and physician] can establish and enhance a good physician-patient relationship built on realism, trust and support.[22]

Teifion Davies believes that a relationship built on these elements must be present when trying to give and obtain informed consent in psychiatric research, as well:

> Again, the groundwork involves fostering partnership with keyworkers, carers, advocates, patients' groups and, wherever possible, the patients themselves.[23]

When patient and physician trust each other, their relationship goes beyond one of doctor-patient, but begins to reflect the relationship between Christ and the Father.

The relationship formed between the physician and the patient should not try to emulate that between a student and a professor in the lecture hall. Instead, this relationship ought to strive to imitate the manner in which God exists. Because God exists as Trinity, i.e., in a community of love, each Person of the Trinity, although fully sharing in the one Divine Essence, accepts and allows the Others' particularities to exist. John Zizioulas reminds his readers that, within the Trinity, "otherness is absolute. The Father, the Son, and the Spirit are absolutely *different*." [24] Thus, the patient and the doctor should make every effort to make their interactions form the same kind of community—of love and acceptance of the other's values. Such a community "is theologically speaking, an ontological category more fundamental than biology, and hence more fundamental than family, race, gender, or class."[25] This relationship or, rather, this state of "being as communion" allows the doctor and the patient to work with one another and accept their various external differences—making the informed consent process more gratifying and complete for both parties.

Conclusion

In Orthodox Christianity, the fact that the Hypostasis of the Logos takes on human nature represents the deepest expression of God's love for creation. By kenosis, uniting human nature and personalizing it to the divine Hypostasis/Person, the pre-eternal Logos once again makes it possible for all of humanity and creation to be reunited with their Maker and partake in divine Glory. The Hypostasis of the Logos has been debated over the centuries. It has resulted in the formulation of great doctrines, but it has also been the center of disagreement and division among believers. Responsibility for these divisions can be placed on the fact that people have lost sight of the union's purpose—to transform human beings into human persons.

Bioethics, a modern discipline compared to theology, provides people with the opportunity to regain the mystery of the Incarnation. The informed consent process, although it often consists of highly technical language and forms, provides human beings with the chance to engage in meaningful relationships with each other. Informed consent no longer has to result in isolated living and decision-making. Through interaction between physician and patient, each begins to live in a state of communion—even if for the briefest moment in an emergency situation the physician and the patient comes to glimpse the vital role each plays in the life of the other. Thus, as people begin to grow in communion with each other, not only does the consent process become more natural, but people also begin to exist in communion with God.

Works cited:

Agre, Patricia, and Kathleen McKee. "Patient Satisfaction with an Informed Consent Process." *Cancer Practice* 5, no. 3 (1997): 162-67.

Baker, Constance H. "Comment: Informed Consent, Obligation or Opportunity?" *Journal of Health and Hospital Law* 26, no. 7 (1993): 214-15.

Baum, J. D., and J. P. H. Shield. "Children's Consent to Treatment." *Bristol Medical Journal* 308 (1994): 1182-83.

Billick, Stephen B., and Bella Peter D. "Competency to Consent to Hospitalization in the Medical Patient." *Journal of American Psychiatry Law* 25, no. 2 (1997): 191-93.

Clapsis, Emmanuel. *Dogmatics Notes.* Unpublished work.

Cole, John. "Research barriers in psychopharmacology." *American Journal of Psychiatry* 133 (1977): 896-98.

Davies, Teifion. "Informed Consent in Psychiatric Research." *British Journal of Psychiatry* 178 (2001): 397-98.

Erlen, Judith A. "Informed Consent: The Information Component." *Orthopaedic Nursing* 13, no. 2 (1994): 75-78.

Faden, Ruth R., Nancy M. P. King, and Tom L. Beauchamp. *A History and Theory of Informed Consent.* New York: Oxford University Press, 1986.

Giannaras, Chrestos. *Elements of Faith: An Introduction to Orthodox Theology.* Edinburgh: T. & T. Clark, 1991.

Hochhauser, Mark. "The Informed Consent Form: Document Development and Evaluation." *Drug Information Journal* 34 (2000): 1309-17.

John of Damascus, Saint. *An Exact Exposition of the Orthodox Faith.* Trans. by S. D. F. Salmond. Nicene and Post-Nicene Fathers: Second Series, Vol. 9. Series ed. by Philip Schaff and Henry Wace. Peabody, Mass.: Hendrickson Publishers, 1999.

Kondo, Douglas G, Bishop F. M., and Jay A. Jacobson. "Residents' and Patients' Perspectives on Informed Consent in Primary Care Clinics." *The Journal of Clinical Ethics* 11, no. 1 (2000): 39-48.

Leiter, John H., ed. *Creeds of the Christian Churches*. New York: Anchor Books, 1963.

Meyer, Ronald. "Subjects' Rights, Freedom of Inquiry, and the Future of Research in Addictions." American Journal of Psychiatry 134 (1977): 899-903.

Meyendorff, John. *Byzantine Theology*. New York: Fordham University Press, 1974.

Schaff, Philip, ed. *The Seven Ecumenical Councils*. Vol. 14, Nicene and Post-Nicene Fathers. Peabody: Hendrickson, 1999.

Shuman, Joel James. *The Body of Compassion: Ethics, Medicine, and the Church*. Boulder, Colo.: Westview Press, 1999.

Vlachos, Hierotheos. *The Person in the Orthodox Tradition*. Trans. by Esther Williams. 1st ed. Levadia: Birth of the Theotokos Monastery, 1998.

Wendler, David, and Jonathan E. Rackoff. "Informed Consent and Respecting Autonomy: What's a Signature Got to Do with It?" *Ethics and Human Research* 23, no. 3 (2001): 1-4.

Van Norman, Gail A. "Competence and Informed Consent: When Is a Patient Not Able to Make Decisions About Medical Therapy?" *ASA Newsletter* [American Society of Anesthesiologists] 63, no. 4 (April1999). Available on the internet at URL <http://www.asahq.org/NEWSLETTERS/1999/04_99/Competence_0499.html>.

Zizioulas, John. "Communion and Otherness." *Sobornost* 16, no. 1 (1994): 7-19.

_____. *Being as Communion: Studies in Personhood and the Church*. Crestwood, N.Y.: St. Vladimir's Seminary Press, 1985.

Endnotes:

1. Part of the Fifth Ecumenical Council's statement. See Schaff, pp. 264-65.
2. John of Damascus, p. 51.
3. Clapsis. Fr. Emmanuel Clapsis is Associate Professor of Theology and Dean at Holy Cross Greek Orthodox School of Theology, 50 Goddard Ave., Brookline MA 02445.
4. Meyendorff, p. 154.
5. Giannaras, p. 59.
6. Leiter, p. 51.
7. Faden, King, and Beauchamp, p. 7.
8. Erlen, p. 75.
9. Shuman, p. 64.
10. Wendler and Rackoff, p. 2.
11. Billick, p. 191.
12. Van Norman.
13. See Cole; Meyer.
14. Baum and Shield, p. 1183.
15. Hochhauser, p. 1315.
16. Ibid.
17. Kondo, p. 44.
18. Agre, pp. 165-66.
19. Giannaras, p. 53.
20. Vlachos, p. 104.
21. Erlen, p. 77.
22. Baker, p. 214.
23. Davies, p. 398.
24. Zizioulas, "Communion and Otherness," p. 12.
25. Zizioulas, *Being as Communion*, p. 60.

Konstantinos Symeonides was born in Thessalonica, Greece, in 1978. He recently earned his M.Div. degree at Holy Cross Greek Orthodox School of Theology and his M.S.T. degree at the Boston University School of Theology, where he studied bioethics under Professor Jensine Andresen. His thesis title is "Religious and Medical Approaches to Death." With principal interests in bioethics and medical ethics, he hopes to help bring Eastern Orthodoxy's voice more fully into the science-and-religion conversation. His ordination to the diaconate is anticipated in the near future.

For this essay, the New England Center for Faith and Science Exchange awarded Mr. Symeonides a year-2001 Publication Prize.

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Toward Integration of Religion and Medical Ethics

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Having practiced neuropsychiatry in communist East-Central Europe for sixteen years, and now studying theology and ethics, the author argues for the necessity of medical praxis that integrates theological thinking. She uses illustrations from her cross-disciplinary and cross-cultural experience to suggest an integrative model. She encounters the dilemma of facing two radically different interpretative models, the cognitive scientific and the theological; and she concludes that she need not choose between them.

Introduction

> [T]he search for intelligibility that characterises science and the search for meaning that characterises religion are two necessary intertwined strands of the human enterprise... essential to each other, complementary yet distinct and strongly interacting—indeed, just like the two helical strands of DNA itself! [1]

These are the words of the winner of the 2001 Templeton Prize for Progress in Religion, the Rev. Dr. Arthur Peacocke of Oxford University. He is not only a renowned physical biochemist—researching and describing the double helix structure of the DNA—but also an Anglican priest and theologian. Dr. Peacocke is a proponent of "critical realism" and recognizes that "both science and religion try to depict reality and must be subject to scrutiny," while admitting their creative interaction. Hardly any words could have been more timely and more inspiring for me. The title of his new book might well serve as the motto for my present paper, my past career, and my future orientation: *Paths from Science Towards God: The End of All Our Exploring.*

As a physician who practiced medicine for sixteen years in communist Romania and Hungary, specializing in neuropsychiatry, and as a current graduate student in theology, I have a strong desire for a coherent synthesis of science and religion. The Spirituality and Health Project, supervised by Prof. Jensine Andresen, Prof. Wesley Wildman, and Prof. Patrick McNamara, not only resulted in a joint publication[2] but also shaped my decision to redirect my future professional life toward an integration of the medical, theological, and ethical fields.

In my medical experience, the correlation between a person's religiosity/spirituality and the state of his or her health has always been an intuited reality. Under communist totalitarianism, however, introducing religious dimensions into the healing process was discouraged, if not banned. Research on such a topic was unthinkable at that time. My participation in the Spirituality and Health Practicum has had a far deeper significance than its face value: it carried the overtone of liberation for me.

Part I: Interdisciplinary Integration: The Spirituality and Health Project

The Spirituality and Health Project was a very informative and personally enriching experience. My task within the project was recruitment and testing of participants aged sixty and older. This recruitment involved an initial questionnaire sent by post, followed by phone calls to those who responded. I had 60 surveys completed by the end of the semester.

The study assumed a direct correlation between religious attitudes/practices and improved physical health. This direct relationship has been observed empirically and proven through scientific studies: prayer and other spiritual practices seem to maintain and even restore health. Some forms of religious practices and prayers are directly related to frontal lobe functions. Our general hypothesis was that prayer and other forms of religious practices that result in health improvement do so partly by involving or activating the frontal lobes. Thus, our task was to investigate the relationship between various religious practices and attitudes, the overall functions of the frontal lobes, and the state of overall health. We postulated that if our assumption about the frontal lobes' responsibility in mediating, "translating" religiosity into health improvement was correct, then people with better frontal functions would have better health or a more positive perception of the state of illness—that is, they suffered to a lesser extent. Also, people with more intense prayer life and religiosity/spirituality were expected to have better health and better frontal functions. Some further predictions could be added to this main hypothesis, and we partially looked into those, such as religiosity protecting against levels of depression that could be responsible for poor health. Another aspect of this study was an investigation of the correlation between religiosity and certain forms of frontal functions—e.g.,the orbito-frontal functions.

While the role and function of the temporal lobes in correlation with religiosity and better health have been thoroughly researched, the role of the frontal lobe has never been the focus of any major study. Thus, ours can be considered as a pioneer one.

A. Method

We collected a wide range of data. The questionnaire (318 questions) was divided into the following sections:

personal data
dimensions and role of religion
frontal lobe functions (verbal fluency test for the left frontal lobe functions, and design fluency test for the right ones)
frontal inhibition or desinhibition (especially characteristic to orbito-frontal disfunctions)

For differential diagnostic reasons, we tested temporal lobe functions, looking into patterns of attachments. With the questions on health, we investigated the subject's style and ability in handling stress, his or her overall perception of health and handling illness, chronic and acute (diagnosed or not) illnesses, discomfort level, and medications. We also tried to detect signs of depression and anxiety.

My responsibility was to recruit subjects in the older age category—around 60 or older. We presumed that frontal functions generally decline with age. I "targeted" a few personal friends whose personality suggests frontal dysfunction or who suffer from epilepsy. Unitarian Universalists comprised the majority of the participant pool, due to my close ties and affiliation with this group. To guarantee a wide range of spirituality and pluralistic religious practices and attitudes, I was especially careful that participants also be recruited from other religious group, among them Roman Catholics, Southern Baptists, Calvinists, and also New Age spiritualists, atheists, secular humanists. Most of the participants were middle class, educated people.

We used non-standard format scoring. For our hypothesis of direct correlation between health, frontal functions, and religiosity—intrinsic and extrinsic—we scored frontal functions, religiosity, and health—that is, seven main variables.

In scoring religiosity, we used Don Batson's scales, focusing on three categories:

(1) religious orientation

(2) religious life (measuring the means, the end, and the quest of one's religious dimensions)

(3) doctrinal orthodoxy (designed to measure belief in traditional religious doctrines, an important component of the intrinsic, that is, the "end" dimension).

In scoring health, I personally was responsible to design and try out the best formula. My medical background and a felt sense of the subject's personality and psychological profile, by virtue of having known some of them for years, was extremely helpful. This study did not employ an impersonal statistical method; rather, a careful analysis of personality that went well beyond the score on the questionnaire. This principle of analysis was used especially in assessing health issues. Some subjects would pay less attention to their reactions than others would, thus frontal and health-related answers clinically seem not always to correlate with the subject's perception. However, the multidimensional aspect of frontal testing and the statistical dimension of the study eventually self-corrected any extreme subjectivity. In testing health, we used several variables: multiplicity and duration of illnesses (diagnosed or not), number of doctor's visits, discomfort, etc. We focused on three basic factors:

(1) severity or life-threatening character of an illness,

(2) the subject's perception of his or her impaired health, based on discomfort level, and

(3) diagnosed or not, chronic or acute illness categories.

A statistical analysis of two variables in our study, frontal functions and state of health, seemed to demonstrate unambiguously our prediction: the better the frontal function, the better the health. The next step was to correlate these with the third variable, religiosity and its types.

We calculated the health index using the following formula:

$$\frac{A \times B}{C} + D, \quad \text{where}$$

A = the sum of diagnosed chronic illnesses and total severity
B = level of discomfort
C = the number of illnesses
D = the number of acute illnesses.

This reflects a reasonable profile of one's objective and subjective state of health.

B. Neuroanatomic and physiological background

The arguments for the benefits of prayer and regular meditation are manifold. The principal factor responsible for the positive effect is hope, a highly positive emotional state. Other major factors are fear reduction and stress reduction, a positive outlook to the future that allows or encourages active planning and volitional strength.

Anatomical structures support the theory. Recent studies show that the traditionally known role of the limbic system in emotional processes is in fact regulated by the orbitofrontal cortex.[3] Thus the frontal lobes participate directly in emotional processes: the left frontal cortex mediates positive emotions, the right frontal cortex mediates negative ones. Consequently, left frontal (orbitofrontal) lesion is likely to cause depression, while right frontal damage leads to uncontrolled maniaform behavior.

Besides emotions, the frontal cortex is also responsible for pro-social behavior, empathy, and moral insight. Lesions of these structures cause a typical personality structure of impulsivity, aggressivity, inappropriateness of the expression of sexuality, a "sociopathic" behavioral pattern.

Self-consciousness is a frontal lobe function and closely correlated with a religious mode of life; most religious practices claim to increase self-awareness. Impairment of the self and of the ability to apprehend the self is a characteristic symptom of serious frontal lobe lesion.

The right frontal cortex is intimately involved also in memory, and thus plays a crucial role in the sense of self-identity. Processes of belief-fixation also involve frontal lobe functions and are the subject of neurophysiological studies. One aspect is one's openness to foreign belief systems.

There is, however, another major supporting physiological explanation for the health-improving effect of prayer and meditation: relaxation and consequent improvement of brain circulation. Electrophysiological feedback studies show evidence for this.

C. Results

A statistical analysis of two variables in our study, frontal functions and state of health, seemed to demonstrate unambiguously our prediction: the better the frontal function, the better the health. The next step was to correlate these with the third variable, religiosity and its types. Our study found that all the examined subjects fit into one of two categories: high religiosity and low religiosity. We found a direct correlation between frequency and intensity of religious/spiritual practices and overall state of health (or perception of it), and the same correlation between frontal functions and health, since the frontal lobes are supposedly responsible for the correlation.

Having been witness to the abuses and manipulations of scientific data and medical practice for political gains in a communist society, I want to raise awareness of risks of possible manipulations—although for different reasons and in more subtle ways—in the affluent society of the United States.

We can summarize the findings in this way: good frontal functions and high religiosity protect people from suffering.

The study of the correlation between spirituality/religiosity and health has definitely convinced me of the value of an interdisciplinary approach in medicine.

PART II: Cross-Cultural Integration: Lessons in Medical Ethics from Communism

The time factor

Since my youth, Albert Schweitzer has been my ideal, because he embodied interdisciplinary excellence—a "renaissance person" ideal. I view my own career changes from music to medicine to theology in a "Schweitzerian" sense. I have never abandoned any profession, rather I have incorporated each profession into the next. I play my violin in churches as often as I preach, and if I ever practice medicine again, I will incorporate religious dimensions into my work.

To illustrate the benefit of the Spirituality and Health Practicum for my interdisciplinary orientation, I recall my experiences as a physician in communist Eastern Europe. There was nothing spiritually quite as fulfilling as being physicians in that part of the world, where medicine represented not only science and a healing art, but also the most complex form of service and ministry. We practiced the art of medicine, and a great part of it was ministry to the marginalized, the abused women, the alcoholics, the elderly. Hospital conditions were miserable, social care virtually absent. So, the physician's attitude toward and relationship with the patient carried a great weight. For six years in a cancer research neurology department, I stood at the bedside of young dying patients, praying with them in their last hour. In a communist country, religious service for the dying and the presence of clergy would not have been welcomed. And younger patients had no religious background. But in the hour of their death in a desolate, inhumane hospital, they needed someone to hold their hand, look into their frightened eyes and help them die in peace. In psychiatric wards, I played my violin during many Christmas observances.

The effect of music—even on Alzheimer patients—was stunning. Touched by music, these patients, in their fading personhood, came alive. "Is it Christmas?" some asked, wakening from years of absence.

During my years of medical practice, my patients consistently commented in words such as these: "When you enter the ward, the sun is suddenly shining and I feel that I am healing." At that time, I was not aware of what this really meant; I dismissed the recurring statements as mere compliment. Only later did I come to understand that the "sunshine" my patients perceived was the Spirit in me, manifested through my compassion and intense love for them in their suffering. Patients who grew up as communist atheists were even hungrier for "spirituality." I used their language to guide them back to resources of their inner selves, to (re)connect them with the divine and their own souls. The secretly religious patients intensely needed the nurturing of that dimension. There is a great power in combining God's gift of the Spirit with good medical practice.

My keen interest in comparative approaches toward bio- and medical ethics stems from my experiences in two radically different societies. Having been witness to the abuses and manipulations of scientific data (particularly concerning AIDS) and medical practice (especially in areas of psychiatry and gynecology) for political gains in a communist society, I want to raise awareness of risks of possible manipulations—although for different reasons and in more subtle ways—in the affluent society of the United States. The ubiquitous presence of special interests and prominence of profit-making necessitate an ever greater ethical vigilance and moral imagination from scientists and religious professionals, alike. Although people's moral sense of what is good or bad, virtuous or evil, ethical or unethical, are basically similar cross-culturally, unprecedented technological developments have made bioethical and medical decision-making more complex and complicated than ever before. Human beings truly need to stretch their moral imagination. Science and its applications, divorced from ethical considerations, could be disastrous; therefore, such divorce should be unthinkable today. Communism offers valuable experiences which, if heeded rather than dismissed, might prevent the repetition of many mistakes.

Medical ethics, in general, continues to be ruled by the Hippocratic Oath as its basic guiding principle. Yet the difference between the ways in which physicians live out their moral values are vastly different in poor societies than in wealthy ones, and under different political systems. I am often puzzled when I read idealized and high-minded ethical treatises, yet watch actual practice under the pressure of the profit-making "industrial" mentality, which forces doctors on occasion to compromise their ethical integrity.

In my experience, one of the most evident compromises lies in the view of *time as money*. In the accelerated pace of Western life, where the greatest achievements of science and technology are available for medical diagnosis and treatment applications, the precious commodity of time is curtailed; a sufficiency of it is often denied to both doctor and patient in the clinical setting. Time is crucial in building trust and a nurturing psychological environment; it is essential for decision-making and healing. The hostile, legalistic mentality of the courtroom often and sadly replaces the failed trust-building process in the medical office.

Take the example of how the principle of informed consent is typically implemented when a patient suddenly faces the diagnosis of cancer and needs to make decisions about life-and-death issues. The extreme pressure of time in the few-minutes-long medical visits, and the perhaps monotonous, almost automated recital of options and consequences—often seasoned with unnecessarily frightening possibilities of side-effects and worst scenarios—only serve to aggravate the patient's stress and, consequently, his or her decision-making will likely be affected. In such circumstances the patient might reject an effective treatment, and, the doctor, respecting the autonomy of the patient, will ultimately fail to serve the patient's best interests. This informed-consent procedure takes place in the name of medical ethical principles, but inhumanely applied.

Now, through my attempt to present some contrasting features of medical practice in a communist environment, where time is abundantly available and ministering to the patient is part of medical practice, I wish to illustrate my main point: the importance of serving the *spirit* of the ethical law, not simply the *letter* of it.

Under communism, medical training was free, subsidized by the state, and so was health care. The physician had no financial investment in practicing medicine—either well or badly. His or her salary was the standard minimum of any other member of the society. There were no insurance companies, no HMOs, and definitely no law suits (frivolous or otherwise) brought against doctors. Paradoxically, in a society so lacking in freedoms, freedom was granted to doctors to practice according to their own conscience. Cost, counted either in time or in treatment, was never a consideration within the limits of available resources. Physicians had as much time as they needed for their patients. In the above-mentioned case of informed consent delivered upon the diagnosis of cancer, the fluidity of the doctor-patient relationship—pejoratively called a "patronizing" model—would allow the doctor to take more responsibility in the decision-making, as a counselor/minister, and as a compassionate fellow human being. The patient's stress due over a diagnosis of a life-threatening illness may already be overwhelming. There is no lonelier space in the universe than that of a person who has just become a cancer patient and is expected to make crucial decisions in the space of a few minutes. A practice can be perfectly ethical, yet inhumane. Compassion has to be added to the rigid letter of rules. The need for strengthening and deepening a society's ethical culture and moral imagination only increases with the advancement of biotechnology.

When cognitive science provides convincing scientific evidence through neurobiology and neuropsychology for a plausible explanation of my experiences of ultimacy, I cannot afford to ignore this evidence. Yet such explanations might threaten to explain away my own valuable experiences of the transcendent.

One might ask how medical practice in Eastern Europe was regulated, if not by legal means. First of all, in my experience, high social status was a true reward for the doctor's conscientious work and self-dedication. Negatively put, social pressure prevented the physician from abusing the trust of society. A genuinely trusting relationship between the physician and patient was key to successful practice. Trust having been established, there was no need to practice a defensive type of medicine. Limited resources were used for the benefit of the patient, not wasted on the doctor's self-defense. Medical practice was based on the assumption that the Hippocratic Oath is ultimately binding, and that doctors have the moral and professional integrity to follow its spirit and do their best in the given situation and technological circumstances. Although medical ethics was not formally taught at medical schools, it was woven into the texture of each discipline.

Another regulating factor was a healthy team spirit among physicians, who felt responsible for each other and looked into each other's work, even critically when malpractice was suspected. Mistakes on the physician's part were considered honest mistakes, and doctors were genuinely trusted. On the one hand, close teamwork among doctors assured reasonable ethical decisions; on the other, patients and their relatives had reasonable expectations of their physicians, and almost never created ethical-legal crises. Physicians were not attributed, nor expected to have, god-like powers. End-of-life care, for example, was not regulated; but a deep sense of reverence for life also included respect for a person's right to die in dignity. Certain aspects of passive euthanasia were a socially accepted part of such respect. Of course, this had to do also with the limited therapeutical resources. Because of the limited availability of medical technology, physicians often faced complex ethical dilemmas and relied on their sense of humanity in solving the. These dilemmas were mostly concerned with the just allocation of existing resources. Communitarian principles were also applied here. No child was ever precluded from immunization. Hospitalization lasted until the patient recovered. Patients were never sent away from emergency rooms or any medical office, unexamined and untreated. Although doctors were free to ask for any lab tests and had access to specialists, it was embarrassing to practice defensive medicine, asking for "umbrella" paraclinical tests. In fact, during the worst years of the dictatorship, doctors were punished if they asked for unnecessary tests—the cost was deducted from their salaries.

I have attempted to draw some valuable lessons offered by the kind of medicine I myself practiced during communism. In the same time frame, however, stand their tragic counterpoints: the most brutal manipulations, especially of medical statistical data, and of the practice of psychiatry and gynecology.

Abortion and birth control issues are increasingly politicized in many parts of the world. But I doubt that it had ever been as brutally controlled and manipulated by any political system as it was in communist Romania. The madness of Ceausescu's "Abortion Decree" turned gynecology and obstetrics clinics into "mother-killing fields." The law forced all women to give birth to a minimum of four children before age 45, and gynecologists were often prevented by secret police agents from intervening and saving the life of the mother when illegal/self-inflicted abortion was suspected. The practice of birth control and abortion was punishable by imprisonment. All women were subject to compulsory periodic gynecological screening to detect pregnancy. Though Ceausescu was not opposed to abortion or birth control on moral ground, the criminalization of them was part of Ceausescu's plan to "rejuvenate" the nation. With increasing poverty and well-known disastrous food and energy shortages, criminal abortion cases were ever increasing. Secret police officers were on duty in the operation rooms of gynecological clinics, watching over the shoulders of the doctors and often preventing lifesaving intervention in hemorrhages after self-inflicted abortions. A woman in this circumstance was treated as criminal and given two choices: either plead guilty, in which case her doctor would be allowed to intervene, or else plead innocent and be left to perish on the operation table. If she pleaded guilty and her life was saved, she would subsequently be arrested for her crime. Women had never experienced such terrors—nor doctors. This policy furnished an endless supply of orphans for state orphanages, where brainwashing, abuse, and AIDS epidemics were considered state secrets.

Conclusion: Integrative Thinking

Grounded in two different cultures and having lived in two extremes of the political spectrum, I find myself at a crossroads in my life and career. I wish to integrate the lessons into a coherent plan as I face the decision before me. Now I turn from issues of applied bio- and medical ethics toward more general integrative thinking. In my view, the integration of science and religion involves a transformation in thinking about and interpreting our life experiences. Arthur Peacocke's remark is a guiding principle:

> [T]he search for intelligibility that characterizes science and the search for meaning that characterizes religion, are two necessary intertwined strands of the human enterprise.[4]

Having made an attempt to sketch an integrative model that is both cross-disciplinary and cross-cultural, I now arrive at the dilemma that is inherent in such integrative approach. Applying the principles of integration to the findings of the Spirituality and Health Project, I have two radically different interpretative modes of my experiences: the cognitive scientific and the theological. The dilemma is this: Do I need to choose between them in order properly to appreciate the effect of my prayer upon my health? Which is the source of my sense of blessedness, zest for life, the overwhelming empathy for people who are suffering? Is it God, or my neurobiological processes?

When cognitive science provides convincing scientific evidence through neurobiology and neuropsychology for a plausible explanation of my experiences of ultimacy, I cannot afford to ignore this evidence. Yet such explanations might threaten to explain away my own valuable experiences of the transcendent. It seems somehow dangerous to ask what "the" truth is. Can two opposing and equally convincing and powerful truths coexist and be reconciled? In the newly enlightened understanding of embodied religiosity, will prayer become utilitarian, merely a means to activate the frontal lobes in order to evoke emotions of bliss and serenity, which then improve my health? "Activate your frontal lobes first, then God will honor your effort." Is this the future of spirituality?

Yes and no. I personally need both the bliss of experiencing the non-embodied One, but I also need and want the blessings of the intellectual enlightenment. In this rich double-rootedness, what I propose is to avoid physical reductionism of the ultimate.

Initially, I felt a sense of threat to "my" God posed by scientific revelations of the biological mechanisms underlying my experience of the ultimate. But after passing the threshhold which seemingly separated the "world of God" and the "world of science," I discovered the vast richness of life; and I gained an ever-deepening sense of appreciation for it. I no longer feel any threat . God is not my brain's creation, but my brain makes God "accessible" for me. The scientist in me is fascinated to find the answer to the *how* question. We are part of nature. If we admire a butterfly or the lilies of the fields, how much more the awe and sense of blessedness awakens in us when we see the marvelous microcosm of our own brain! My knowledge is divine gift rather than a threat to my faith. It enriches the awareness of life's extended dimensions rather than takes away from it. I believe that if one feels threatened by the illumination of science, it is perhaps because of insecurity in one's faith.

There is no incompatibility between my God-experience and my self-understanding of it. Communist propaganda brainwashed the scientists to believe that a commitment to science necessarily precluded any commitment to religion. Reconciling science with religion in communist ideology was unthinkable. Political freedom's precious gift to me is also an intellectual freedom: one can carry out scientific research with reverence for life and in awe of God. As philosophical theologian Wesley Wildman and psychiatrist Leslie Brothers wrote,

> We are not forced to choose between a blunt realism about ultimacy and a hermeneutical disengagement from reality[5]

And the more deeply that scientific knowledge penetrates the veil that covers the miraculous complexity of the human nervous system, the more grounded becomes my relationship with the transcendent.

By virtue of having a marvelously sophisticated nervous system, I am able to have the richest, the most complex experience possible: experience of the ultimate. Through my "free radicals" of longing for the transcendent dimension of life, I connect, I tap into a God-consciousness. I become aware of the indescribable, unnameable, unimaginable divinity, the eternal, Tillich's "ground of Being." Yet I experience it as present within me, loving me, changing me—not as an intentional "Being" but as a reflection of It in my own being, thus making me a "drop" of the divine. My experience is that reflection of the One who is beyond existence, and who has no other way to reveal Godself to me, a part of nature in time and space, except through my own biological makeup, through my neuropsyche.

Will the awareness of, the insight into, the mechanisms of the experience diminish the experience? I think they rather enhance it. It is impossible to glimpse the depth of creation and the wonder of the neurobiological processes—which ultimately enable us to glimpse—without a deep sense of awe and admiration for creation. Knowing and naming the vehicle, the triggerer, the enhancer of the experience won't discredit it, because my quest is no longer focused on the cause of the experience, but rather on its transformative effect upon my reality.

I no longer particularly worry about what exactly was the cause of my experiences—an intentional God or neurobiological circumstances. Surrendering a strict cause-and-effect view of experience has helped me. What matters is the value of the experience in my life, which has been changed dramatically by those experiences. Giving up a causal commitment in favor of the empirical aspect of the experience,

> delegitimates the debates about whether or not real contact with some sort of Ultimate occurs in religious experiences.[6]

My experiences are relevant because they are meaningful to me; I am she who reads my meaning into them. This allows both a relative neutrality and a subjective engagement that grants the benefit of the experiences to the fullest toward my spiritual health and growth. This worldview mandates the integration of religion with medicine as science and art. The way of the future is indeed "science towards God: the end of all our exploring."[7]

Works cited:

McNamara, Patrick, Jensine Andresen, and Judit Gellérd. "Religiosity and Health in Community Dwelling Elderly: Possible Role of the Frontal Lobes in Mediating Effects of Religiosity on Health." *Journal of Gerontology*, forthcoming.

Peacocke, Arthur. *Paths from Science Towards God: The End of All Our Exploring.* Oxford: Oneworld, 2001.

_____. Statement at the John Templeton Prize News Conference, 8 March 2001. *Bulletin of the Society of Ordained Scientists* 27 (Easter 2001): 24-26.

Rolls, E.T. "The Orbitofrontal Cortex." In *The Proefrontal Cortex: Executive and Cognitive Functions*, ed. by A.C. Roberts, T. W. Robbins, and L. Weiskrantz, 67-86. Oxford: Oxford University Press, 1998.

Wildman, Wesley J., and Leslie A. Brothers. "A Neuropsychological-Semiotic Model of Religious Experiences." In *Neuroscience and the Person: Scientific Perspective on Divine Action.* Ed. by Robert John Russell, Nancey Murphy, Theo C. Meyering, and Michael A. Arbib. Vatican City State and Berkeley, Cal.: Vatican Observatory Publications and Center for Theology and the Natural Sciences, 1999.

Zald, D. H., and S. W. Kim. "Anatomy and Function of the Orbitofrontal Cortex." *Journal of Neuropsychiatry and clinical Neurosciences* 8 (1996): 249-61.

Endnotes:

1. Peacocke, Statement at the John Templeton Prize News Conference, p. 24.

2. McNamara, Andresen and Gellérd.

3. See Rolls; Zald and Kim.

4. See n. 1.

5. Wildman and Brothers, p. 350.

6. *Ibid.*, p. 410.

7. Peacocke, *Paths from Science Towards God.*

Judit Gellérd grew up in Transylvania. Her father was a Hungarian Unitarian theologian and martyr of communist persecutions. After graduating from music conservatory, she earned her medical degree. She practiced medicine for sixteen years, specializing in neurology and psychiatry in Budapest. In 1988 she married Professor George M. Williams and moved to the United States. For the past twelve years, Judit has served as a volunteer organizer and leader for the Unitarian Universalist Partner Church Program of 400 churches, the largest Unitarian Universalist grassroots movement of the century. She has translated, edited, and published her father's life scholarship in theology. In 1995, she received an honorary doctorate (L.H.D.) from Starr King School for the Ministry, in Berkeley, California; and in 1999, she was given the "Living the Mission" Unitarian Universalist Partner Church Award.

In 2002, Dr. Gellérd completed her M.T.S. degree summa cum laude *from Boston University School of Theology. She also received a Certificate in Science and Religion, given through the faculties of the member schools of the Boston Theological Institute. Currently she is working on an oral history project at Boston University under the direction of Professor Elie Wiesel.*

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A Greek Orthodox Priest's Experience in a Medical Laboratory

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The author describes his experience as a Greek Orthodox priest working in the field of medicine. While in medical school, the author had the opportunity to work in a laboratory that sought to provide to government authorities the results of genetic testing regarding paternity. Although his role in the entire process was minimal, he confronted several ethical issues involving informed consent, autonomy, and freedom. In addition, he often found himself in difficult situations where being a priest and a celibate complicated his obligations as a staff member in the laboratory.

During my second year of studies at University of Crete Medical School, my advisor, Dr. Michalodemitrakis, asked whether I would like some lab experience. I had very little exposure to the laboratory and saw this as an opportunity to participate fully in the scientific research process. After a few days, I was asked to visit to the lab.

When I arrived, I was required to complete a number of standard consent forms in order to participate in the research being conducted. I also had to sign several waivers that, in general, absolved the laboratory and its affiliates of any responsibility for any accidents or illnesses that might occur while I was working there. At the time, I felt that this was a tedious and worthless process. Later, after taking a course in human rights, I came to understand the importance of knowing what one is volunteering for. The lab is ethically responsible for informing research participants of any risks that they may encounter as part of the whole research project. This important step in the process ensures that there will be fewer issues if a problem should arise. I write fewer, because one can never plan for every possible contingency.

This particular laboratory specialized in human DNA testing and served mostly women who sought genetic clarification of the paternity of their offspring. My task was to draw blood from the men and children who came in to be tested. Many of the women who visited the lab were single mothers who had had multiple sexual partners; others were married women who had had sexual relations outside of marriage.

In Greek society, there are severe social consequences to bearing children outside of marriage, and, if the woman is married, to having children with men other than their husbands. If a man is not married to the woman who bears his child, he does not have any legal or financial responsibility toward the child or the mother and, therefore, he can choose to have nothing to do with them. Unmarried women faced many dilemmas. If a woman's lover chooses to take an active part in the child's upbringing, then the future of the woman and the child seemed a bit brighter. The woman might receive proper financial and emotional support from the child's father, which any mother needs to really be able to raise a child. The child would grow up with the support and love of both parents. Having received such love and nurturing during its early years, the child will have a better chance to grow up as a mentally and emotionally stable person and contributing member of society.

If the father of the child does not take any responsibility for his child, the woman and the child face a bleak future on their own. This situation places a severe financial burden on the mother of the child. In addition, the social stigma of having a child out of wedlock in Greece often forces the woman and/or her family to engage in extreme behaviors. (e.g., hiding the child from the community in order to protect the family's reputation). In such a situation, the mother of the child finds herself caring for a child whose very existence is cloaked in secrecy. These pressures create ethical problems for the mother that may have psychological consequences for both the mother and the child. Many women end up turning to prostitution, without their families' knowledge, in order to raise money to care for their children. This in turn creates additional social problems, such as drug trafficking and the spread of sexually transmitted diseases.

The circumstances of the married women who came into the lab were slightly different. These women usually did not inform their husbands that their children had undergone DNA testing. If the results came back negative and the child's father was the woman's husband, then most women would say that they were going to forget that the affair had ever taken place. If the paternity results confirmed that the lover was the father, then the woman faced a new set of problems. Most of the time the lover did not want anything to do with the child and would be agreeable to the woman raising the child as if it were her husband's. However, if the man wanted to be a part of the child's life, then the situation had to be acknowledged and the woman's husband and family would have to be notified. In these cases, one can imagine that the marriage might end in divorce, or, if the husband were loving and understanding, the other man might became an active presence in the child's life.

In retrospect, I find ethical problems with the fact that many of the husbands were unaware that the child they believed to be theirs was undergoing DNA testing. It seems to me that a man has a right to know about medical procedures performed on a child presumed to be his own. Even if the DNA tests proved that the child was not his, the father should still have the right to know about and even to refuse the testing. If the woman's husband is willing to treat the child as his, I do not think that anything should change if the tests showed the father of the child to be the lover and not the husband. Of course, others may argue against this stance since the biological father, if not the woman's husband, may want to share responsibility for or have custody of the child.

This entire testing procedure was tedious and arduous for all those involved. People waited for the results to arrive as if they were waiting for God to speak to them. The atmosphere of the lab was very tense and often very depressing. Women, grasping their children as if their lives were in danger, would simultaneously argue endlessly with the men who accompanied them.

Being part of the laboratory staff placed me in a unique and sometimes uncomfortable position, because I was a priest and celibate.

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For one thing, people often believe that a celibate priest cannot possess any insights into the life of a married person and that he should never get involved in the concerns of couples. For another, many of my colleagues in the lab used to approach me for advice with their own personal problems. And further, a conversation about an entirely different matter would often lead into a kind of confession of how it feels to conduct tests that have such severe social consequences for those involved. Many of the students and other volunteers felt emotionally drained after having conducted these tests and delivered the results. Additional tension arose because some of my coworkers did not appreciate having a clergyman among them, and their animosity made the laboratory an extremely difficult work environment. There were many times when I would ask for assistance from volunteers who would simply ignore me.

My priestly status also affected many of the men and women who came in to be tested. Quite often, the women were reluctant to have me performing DNA tests on their children. I believe that they must have felt that I was condemning them for their actions. Another concern that they may have had was whether or not I was associated with one of their family members through the church community. They may have thought that I would announce the test results to their relatives.

My ordained status also contributed to the way some women would approach me with their problems with a sense of desperation. These were the women whose lovers wanted nothing to do with them or their child. They looked to me for an answer if everything else failed: if their would not take any responsibility for their children, then perhaps the Church would be a safe haven for them. These patients were the hardest to work with; those who did not want me to handle their case simply did not interact with me. These same women, on the other hand, seemed as if they were never going leave the lab. Even after their testing was completed they would frantically yell and cry for help. Unfortunately, there was little that I could do for them at that moment, as the restrictions that the laboratory placed on me required me to act more as a detached scientist and less as a caring priest in these situations.

The men who came in with the women were much more comfortable with my presence in the lab and were very respectful when speaking to me. They did not see anything wrong with their actions: in their eyes, it was natural for a man to have numerous sexual encounters, even with women who were already married. I believe that they truly felt guilty about the situation that had resulted, however, and thought that consenting to DNA testing was the least that they could do.

Most days in the laboratory were very routine. The laboratory would see approximately three or four cases per day. During my two months there, one case in particular stands out. One morning, two police officers escorted a woman into the lab along with three men, all three in handcuffs. I did not understand what was happening and thought that perhaps we had made a drastic mistake with the results of a test, that this woman was coming with her brothers or cousins to start trouble, and that the police had apprehended them before they had the chance. After one of the police officers presented an official government document to me, I understood the situation.

The woman, after having several sexual encounters with each of these three men, had become pregnant. She had decided not to abort the fetus, thinking that one of the men would eagerly take responsibility for the child. She eventually gave birth to her son. The only problem was she did not know which man was the father. None of the men wanted to deal with her or her child, and none wanted to take responsibility for the child. For the most part, contemporary society does not view having multiple sexual partners as problematic, but in this case, an ethical crisis arose. Despite every effort by the woman to get the men to volunteer to undergo the DNA tests, each turned his back on her. In such cases where the suspected father does not want to comply with the woman's request to undergo DNA testing, the government of Greece can force him to be tested. The man has no recourse but to comply with the law or be placed under arrest. The police officers were basically making sure that all three men went through with the procedure. There were no measures that the laboratory could take to protect the rights of these men, because the lab itself is also subject to the laws of the government.

At first, this situation did not seem especially problematic to me, from an ethical standpoint. I felt that since the three men were responsible adults who willingly participated in sexual relations with this woman, they should be responsible enough to go through with the steps needed to support the life of the mother and her child. Issues regarding the violation of individual human rights and freedoms never crossed my mind until later. As a priest, I understood the value of the individual and how important it is to treat everyone as an individual, but the relevance to this case did not occur to me at first. When I saw the young woman come into the laboratory with the three men, I really did think that the suspected fathers should have their rights suspended until they went through with the testing procedure.

If the principle of autonomy prohibits procedures and actions considered ethical, such as providing medical aid when available to a sick person, then one must wonder what will happen when a person loses his or her autonomy.

The position of the Greek government in instances like this can be excused—or at least understood—when one not only sees the social and economic crises that may occur for the woman and her child, but also takes into consideration the medical threat that may arise when both parents of a child are not identified. For example, if the father is a carrier of some genetic disease, then there is a chance that the child may carry the defective trait or may even express the disease. If the child is a carrier and does not know it, then future generations may also inherit the defective gene. If genetic information about the biological father can be accessed, then early therapy and treatment of disease in the child might be possible.

In addition, should the child ever need some type of transplant (e.g., bone marrow, kidney) in the future, often the father of the child is considered to be a potential donor, as well as the mother. If the family of the child at least knows the identity of the biological father, they can always attempt to elicit his cooperation. Also, if doctors are able to identify both parents, then they may be able to screen people in both of their immediate families for matches. Knowing the identity of both parents greatly increases the chances that the child will survive any potentially life-threatening medical problems and procedures.

One must question if this reasoning is adequate enough to warrant the violation of personal autonomy and individual human rights by the government in mandating genetic testing. Can one person's rights to autonomy be put aside in order that another person or group of persons may benefit? Are the rights of the men to refuse a medical procedure in this situation less important than the right of the child and mother to know paternity? These questions did not cross my mind until later, when taking several bioethics courses taught from the interdisciplinary science-and-religion perspective. Having had previous experiences with bioethical issues, I now realize that if there were adequate standards in place, then violations of freedom and rights would not occur. If bioethicists can show that standards they propose do in fact look out for the general welfare of society and individuals, there is a chance that they can influence the creation of innovative laws that are applicable to a variety of situations (e.g., in biotechnology, medicine, and science, in general). Although as a Greek Orthodox priest, I continue to hold firmly to my faith, I have also learned that there are many instances when theology can learn from both ethics and science. This is precisely one of those situations.

Respect for individual autonomy is an excuse that is widely used in today's medical ethics to allow euthanasia and/or physician-assisted suicide. However, through my bioethics studies, I believe that such procedures are not only unfair and dangerous for the individual requesting them, but also dangerous for the rest of society. If the principle of autonomy prohibits procedures and actions considered ethical, such as providing medical aid when available to a sick person, then one must wonder what will happen when a person loses his or her autonomy.

I had to remind myself that even though I was a priest, at that moment I was also a clinical scientist and not able get too deeply involved in the patients' personal lives. I found it was very difficult to play both of these roles simultaneously.

Should experiments and medical procedures be performed on those whose autonomy has been taken away? Is such action not ethical? I believe that Greek law is wrong in this situation. Although the motivation behind this action is sincere, governmental infringement on individual rights sets a precedent for future violation of human rights and freedoms. If any government has the right to force someone to undergo a test without the proper legal trial or consent, then what will stop that government from forcing its citizens to undergo genetic screening to determine, for example, any predispositions to particular diseases or behaviors? Can secret testing be stopped if people do not have the right to refuse to undergo testing altogether? Individual autonomy must be a primary principle that is respected by individuals, governments, and other society-sanctioned organizations.

During the period of time I spent at the lab, I tried my best to relay the love of the Christ toward all the patients and colleagues I worked with, while at the same time remaining focused on the fact that I was in a scientific environment that placed restrictions on my priestly role. I had to remind myself that even though I was a priest, at that moment I was also a clinical scientist and not able get too deeply involved in the patients' personal lives. I found it was very difficult to play both of these roles simultaneously. Neither was avoidable; I could not stop being a priest, nor could I disengage myself from my scientific duties and responsibilities.

The impact that religion and religious figures play on science and scientific research is real. Since the time of Galileo and Copernicus, science and religion have always confronted each other on key issues (e.g., evolution and creation). Only recently have the two tried to make an effort to see Truth in each other. From my experience in the laboratory, I realized that religion plays a vital role within scientific research that should never be eliminated. Science continues to make new discoveries every single day, yet people are not always able to comprehend many of these discoveries and their concomitant effects. Religious training enables a person to communicate important understanding of how these discoveries impact human lives. I believe that the theological training of clergy should train them to do this, and also that God bestows this gift upon the clergy. Scientific and technological discoveries can sometimes be hazardous to the well-being of God's people.

It is up to the pastor to develop this ability to the fullest and to use it in order to help, comfort, and explain the affects that science and technology have on the lives of parishioners. If I had been to provide this pastoral comfort and attention to even one of these patients, then the results that appeared on paper may not have seemed as frightening to them.

Religion has other important contributions to make to the scientific realm. There is always the fear that science will take its technology and its zeal for progress too far. The technology to perform amazing feats such as human cloning may be accessible to science, but one has to stop and wonder whether or not it is ethically or morally acceptable to pursue these activities. If one applies ethical and moral teachings from various religious groups, one may be able to devise a universal code of bioethical conduct. The knowledge and simplicity of the early fathers of the Church can provide modern science with the conscience that it lacks.

This past year has been truly an eye-opener for me. The science-and-religion courses as well as the various ethical courses that I have taken have revealed to me a different manner of thinking. Although I am still a Greek Orthodox priest and continue to hold firmly to my faith's beliefs, dogmas, and traditions, I have also learned that there are many instances when theology can learn from both ethics and science. At the same time, any course in ethics reveals that science alone does not have all the answers to problems that daily confront humanity. The legal systems of most, if not all, countries are not ready to handle the swift pace of science. This is where the various other fields of study, such as theology, philosophy, sociology, psychology, are able to provide science and the judicial system with helpful perspectives on the issues at hand. When science, theology, and philosophy learn to hear and mutually respect each other's voices, then and only then can society continue to move forward.

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Coyote Medicine and Biotech Culture: Mad Scientists, Jesus and Evil Aliens, and the Dangerous and Uncontrollable Power of Women

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The author explores a dialogue between Native American religion and culture, Christianity, and science, for the purpose of determining some ways in which Native American religious tradition can offer a helpful perspective and corrective for some of the theological and ethical dilemmas that arise from historical interrelatedness of science and "conquering" Christianity. A kind of secular Christianity-of-conquest has been used as a justification for unreflected and ethically dubious choices in science. Working with Trickster stories and concepts, is it possible to engage the teachings of Jesus in new and subtle ways to make critical assessments of developments in biotechnology?

Whether we know it or not, we all live under the influence of "biotech culture." Biotech culture encloses the entire world, mapping the planet from outer space as it maps the genes in our bodies, attempting to reduce all living things to the status of data and property through global commerce, the use of bioinformatics, patenting and international law. It is a culture ruled by science and technology, controlled by computers, and defined by a belief system that has strangely evolved from mainstream Christian doctrine to become something totally other, totally secular and totalitarian in its effect. It is a culture that encourages progress at any cost, and measures success in terms of financial profit and technological novelty. It is a culture that resists all attempts at controls placed upon its relentless advancement, despite the clear need for such controls. What has this got to do with religion, Native American or otherwise?

Vine Deloria suggests an affinity between Native American religion and science in many of his writings, including *God is Red: A Native View of Religion* (1972) and *The Metaphysics of Modern Existence* (1979), and more recent works such as *Red Earth, White Lies: Native Americans and the Myth of Scientific Fact* (1997). I will explore that relationship and suggest further that Native American religion offers a needed theological and ethical perspective to the mainstream scientific view of things. In particular, Trickster stories offer excellent material for reflection where science is concerned, and Coyote is my favorite Trickster.

In "Trickster: The Sacred Fool," from his book *Other Words: American Indian Literature, Law, and Culture*, Jace Weaver discusses how the many variations of Trickster represent the way things work in liminal spaces.

> Trickster is a breaker of barriers and an eraser of boundaries. He moves between heaven and earth, between deity and mortals, between the living and the dead.[1]

Weaver goes on to explain:

> [Trickster is also a] creative figure, but he does not create the world. Rather he is a demiurge who shapes the world and gives it form.[2]

Trickster is not evil but may play tricks and can be cruel; Trickster is usually in trouble or causing trouble. He is a sacred clown. He is a teacher. Trickster appears in many forms in Native American religion, often as an animal, usually an animal that lives "in close proximity to humans but liminal to their settlement."[3] Coyote is the sort of animal that lives in liminal spaces. In mythic or archetypal or religious terms, Coyote travels the liminal spaces not only of geography but of the mind, of the heart, spaces in individuals and in society. These spaces include the intellectual and spiritual place in which scientific discovery and new technologies are born, the global-commerce/techno-wired world, and the bodies of women. All of these places involve power relationships and are connected to or affected by biotech culture. In order for us to learn how to live in or near such a culture, we need Trickster.

One of the basic principles around which many Native American religions are organized is the appropriate way to deal with energy or power: the power of the elements, such as rain, lightning, or thunder; or the energy relationships between Earth creatures and these powers, or between each other. Traditional Native American religions carefully delineate these relationships, and culture instills these core beliefs into ritual practice. Through proper action, the balance of power is assured and there is a clear and steady flow of energy between poles. When the energy gets blocked and unbalanced, that is when trouble occurs. At such times, it is imperative that opposite poles be anchored and solidly grounded. Without grounding, the danger is very real that these energies can collapse in on themselves or fly out of control into a state of total chaos—all situations illustrated by Trickster stories.[4]

Consider the following Cheyenne Trickster tale:

> Because the Great Mystery Power had given Coyote much of his medicine, Coyote himself grew very powerful and very conceited. There was nothing, he believed, that he couldn't do. He even thought he was more powerful than the Great Mystery, for Coyote was sometimes wise but also a fool. One day long ago, it came into his mind to dance with a star. "I really feel like doing this," he said. He saw a bright star coming up from behind a mountain and called out: "Hoh, you star, wait and come down! I want to dance with you."
>
> The star descended until Coyote could get a hold of him, and then soared up into the sky, with Coyote hanging on for dear life. Round and round the sky went the star. Coyote became very tired, and the arm that was holding the star grew numb, as if it were coming out of its socket.
>
> "Star," he said, "I believe I've done enough dancing for now. I'll let go and be getting back home."
>
> "No, wait; we're too high up," said the star. "Wait until I come lower over the mountain where I picked you up."
>
> Coyote looked down at the earth. He thought it seemed quite near. "I'm tired, star; I think I'll leave now; we're low enough," he said, and let go.
>
> Coyote had made a bad mistake. He dropped down, down, down. He fell for a full ten winters. He plopped through the earth clouds at last, and when he finally hit the ground, he was flattened out like a tanned stretched deerskin. So he died right there.[5]

But the story doesn't end there for Coyote doesn't remain dead. In fact, when he is back on his feet, he is especially pleased with himself and sees his survival and recovery not as a gift from Great Mystery, which it is, but rather as indication of his own extraordinary power. His arrogance knows no bounds and, not having learned his lesson, Coyote next takes a ride on a comet, which turns out to be the fastest thing in the universe. Coyote has made another bad mistake and, indeed, eventually he is actually blown to bits by the sheer force of the ride.

This story is an excellent reality-check when seen as a parable or cautionary tale for the process of scientific discovery. Consider the dance of Coyote with the star as the relationship between scientists and research into the atom, the development of nuclear technologies, the dangers and failures that are now known to have resulted from the arrogance and carelessness of scientists who did not really understand the existential reality of the power they were dealing with and saw their own power as more than adequate to handle any situation. Have the lessons of those scientific failures been learned? Are the scientists engaged in cutting-edge research into the human genome or the genetic manipulation of seed crops likely to be more cautious, more humble, perhaps? Considering the track record of the biotechnology industry so far, the answer would have to be a resounding "No, they have not!" In fact, like Coyote, they appear to have missed the point completely. Feeling more powerful than ever, they delve into the very structure of living things, unraveling genes, splicing together the living material of animals and plants, and so on. They too may be on a wild ride through the sky on the fastest thing in the universe, destined to end in a disaster. On the other hand, these scientific endeavors may possibly lead to powerful and important new healing techniques and real advancements in agriculture; they may also lead to greater understanding of the nature of living things and the interrelatedness of all life. The beauty of Trickster stories is that they allow for both possibilities because of the essentially amoral nature of Trickster energy; it does not belong at either pole of a system of good and evil, but dances madly back and forth and all around.

Some Native American communities are particularly attractive to biotech enterprises involved in gathering genetic material from "controlled" populations with relatively homogenous genetic patterns. The fact that data on many Native American populations has been carefully collected for over a century is another reason these communities are attractive to researchers. And finally, more cynically, there are many Native American communities that are highly vulnerable to outsiders who can make big promises, though offering little of real value, in exchange for the last thing many Native Americans have left to be relieved of—the blood running through their veins, the physical manifestation of their indigenous existence and attachment to the land.[6] Fortunately, many such communities and tribal governments have been or are in the process of developing ways to protect themselves, legally and culturally, when outside researchers come calling. Some communities are even finding ways to collaborate with researchers in ways that benefit individual study participants, the whole community, and society at large.

One of the basic principles around which many Native American religions are organized is the appropriate way to deal with energy or power: the power of the elements, such as rain, lightning, or thunder; or the energy relationships between Earth creatures and these powers, or between each other.

So, how does Jesus fit into the picture? And evil aliens? *Evil aliens?* Consider Jesus first. On the one hand, if those involved in the various enterprises associated with biotechnology chose to look to the life and works of Jesus Christ in order to find the best path through the complex choices and endless ambiguities they face, it would be a great comfort. That Jesus is a Trickster—breaker of barriers, opener of doors, crosser of all kinds of boundaries—seems to be an unarguable point if one bases one's opinion on Gospel. However, in "Trickster: The Sacred Fool," as Weaver discusses the Christian/Native encounter and Jesus as Trickster, he makes the salient point that the ambiguity inherent in such a figure does not sit well with "modern society/the church/those in power/the West." [7] Unfortunately, it is precisely that ambiguity that is required if one is to think with any clarity about biotechnology. The differences between Native American religions and Christianity that Deloria lays out, particularly differences relating to space/time and history/geography, suggest a necessary counterpoint to the often short-sighted view preeminent among many of those advancing biotech culture.[8] So, though Jesus *ought* to be and *can* be a teacher and a guide for Christians pondering weighty biotech issues, he is not necessarily going to be regarded as such.

Then again, the secularization of Christianity in the U.S. and its political and economic ties to big business suggests a problematic and chilling theological and ethical situation where conflicts of interest, a strong culture of denial, and an inability to deal with ambiguity in public debate does not bode well for meaningful Christian participation in dialogue about biotech culture. Yes, Jesus is clearly a Trickster, but Christianity has become so closely tied to scientific progress that it has little credibility as an honestly critical institution at this point. This doesn't mean Christian theologians and Christian ethicists shouldn't be addressing biotech issues – they should – but it is vitally important to admit that real conflicts are inherent in the complicated relationships between Christianity and biotech culture; it is vitally important to acknowledge the need for especial rigor in looking at these relationships in the context of making judgments and decisions that affect whole communities of human and nonhuman experience and existence in vast and often permanent ways. It is vitally important for Christians to reclaim the Trickster in Jesus.

In contrast to the Christian situation regarding biotech culture, the way in which Native American religions have survived hundreds of years of colonization, and the way in which they has been revived in the past twenty years are both points in favor of Native religions' being separate enough from mainstream power structures that they can offer some clear vision about what is going on and what ought to be done about it. In *God is Red*, Deloria wrote:

> [T]hrough nearly two decades while American Indians were rediscovering the integrity of their traditional religions, the rest of American society has torn itself and its religious traditions apart, substituting patriotism and hedonism for old values and behaviors.[9]

Deloria goes on to a discussion of the social gospel and the Church's involvement in the Civil Rights movement, and he shows an interesting view of how mainline Christian churches have become enmeshed in strange relationships with government and big business, acting as a critical check at times, but restricted in very particular ways—fenced into realms of acceptable critique, and fenced out of the most important areas where the biotech industry is concerned.

> When the social gospel was brought into full confrontation with the American political system in the Civil Rights movement (and there was plenty of social gospel ideology in the War on Poverty), traditional Protestant theology thwarted its realization.[10]

Deloria's critique of *scientific* dogma is no less compelling than his critique of Christianity and the churches. He challenges scientific sacred cows such as evolution,[11] and embraces the work of controversial figures. I think his long digression into the work of Velikovsky, for example, is not simply a statement of his personal views on this alternative take on the history of the world and everything in it. As he admits, Deloria's agenda is to "create a new understanding of planetary history." [12] I think Deloria is pushing the Trickster motif really hard here, telling provocative scientific stories, thereby demonstrating that anybody can find a theory and data to prove a point. Like biblical proof-texting, this kind of scientific proof-texting may lead to a tightly knit argument that ap-

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pears to make sense, though it may have nothing to do with the reality of collective experience. By deliberately choosing a controversial view, a view which many consider ridiculous, Deloria is playing the Trickster himself.

We will probably never know if the world was originally populated by evil aliens (or even benign ones), though perhaps Deloria would suggest *that* as a focus of human genetic studies. Rather than take blood samples of Native peoples in order to search for lucrative new genetic treatments or to segregate the human race better, *why not* search the genetic material of the European conquerors? *Why not* look for "tracks" of evil aliens within the DNA of the conquerors? Is it possible that Deloria has seen too many episodes of "The X-Files"? Or is this another way in which the need for questions and checks on the unregulated researchers can be tackled?

So, then, what about Trickster and *women*? Some of the most worrisome developments in biotechnology are closely or directly related to issues around women's power, the power of bringing life into the world. Some might argue that the most praiseworthy aspects of biotechnology are its offerings of fertility to the infertile. What could be more sanctified, more biblically correct? Abraham and Sarah would have been thrilled had they been given the option of an in-vitro fertilization, would they not? The other traditional realm of women's power, agriculture and the care of seeds, is another place where biotech offers brilliant solutions to age-old problems. Such offers should be examined closely.

In most pre-contact Native American cultures, women's power was highly regarded. It was understood that women, like Mother Earth herself, were a source of life; women's place in the community was to give it life through the birthing of new members, as well as through the process of feeding power into the people. It is a mistake to discount the careful way in which Native American women approached (as many still do) their work of growing, gathering, and preparing food. All of these activities were (and are) rituals in and of themselves. In a sense, women function as medicine people from puberty on: they are always working with power.

At least until recently, most scholars and researchers have been dismissive of the roles of Native American women.[13] For the most part, women have been relegated, by anthropologists, ethnographers, and other social scientists, to the margins. Many descriptions of women in Native American cultures lead one to believe that menstruation is a particular problem, that for its duration women are considered "polluted" and dangerous, and that they are constrained from interaction with the rest of the community and treated as pariahs. It seems likely that this is an ethnocentric projection of the Judeo-Christian purity codes onto Native American cultures. The impression is given that menstruation itself is somehow the defining characteristic of a woman's place in her community. This interpretation misses the point in serious way. Menstruation is no more the defining characteristic of women's place or women's power than the disappearance of the moon is definitive of its course through the sky or its profound and powerful effect on the earth and its inhabitants.

Women's power resides in women's nature, in the ability to connect directly with life force. This power waxes and wanes (like the moon) and appears to various effects at different stages of a woman's life, a fact evidenced throughout Native American ritual and alluded to in many Trickster tales. Coyote is often getting into trouble because of his attempts to steal power from women or by transgressing the rules about how women's power is to be kept in balance. Women's power shows itself in all phases and experiences of women's lives: childhood, puberty, virginity, fertility, heterosexual activity, homosexual activity, pregnancy, childbirth, postpartum, menstruation, menopause. The multivariate nature of women's power cannot simply be replicated in a Petri dish, by in vitro fertilization. Again, Trickster might serve as educator in response to biotech culture's misappropriation of women's power. Space does not allow more Coyote stories, but Coyote's misadventures with girls and women usually have hilarious results, often resulting in Coyote's losing various and sundry (and sexual) body parts, or even his life—until the next time. The girls and women are often given valuable gifts in the process.

To sum up, Trickster stories teach about the boundaries and oppositions that are a necessary part of life in a universe powered by negative and positive energies/polarities. It is Trickster's ability to maneuver in, over, and around complex arrangements of power, suffering extreme consequences but always coming back to test the limits another time, that makes for an excellent balance of powers. At the same time, it perhaps suggests hopeful possibilities for one of the most extreme endeavors of human beings in relation to life itself, that of biotechnology. Unlike Western thought, which sets up hierarchies and slices these ambiguous relationships of opposition into discontinuous opposite polarities, traditional Native American thought allows for more give and take, for a greater fluidity between poles; it may even offer a guide for Christian thought to engage itself with biotech culture in new ways, more subtle ways, in order to offer a critique that has genuine integrity, to reclaim the Trickster Jesus.

Works cited:

Beck, Peggy V., Anna L. Walters, and Nia Francisco. *The Sacred: Ways of Knowledge, Sources of Life*. Tsaile, Ariz.: Navajo Community College Press, 1977.

Deloria, Vine, Jr. *God is Red: A Native View of Religion*. 2nd ed. New York: Putnam, 1972.

_____. *The Metaphysics of Modern Existence*. New York: Harper & Row, 1979.

_____. *Red Earth, White Lies: Native Americans and the Myths of Scientific Fact*. Golden City, Colo.: Fulcrum, 1997.

Erdoes, Richard, and Alfonso Ortiz, eds. *American Indian Myths and Legends*. New York: Pantheon, 1984.

Klein, Laura F., and Lillian A. Ackerman, eds. *Women and Power in Native North America*. Norman, Okla.: Oklahoma University Press, 1995.

Weaver, Jace. *Other Words: American Indian Literature, Law, and Culture*. Norman, Okla.: Oklahoma University Press, 2001.

Endnotes:

1. Weaver, p. 248.

2. Ibid., p. 249.

3. Ibid., p. 251.

4. Beck, pp. 297-298.

5. Erdoes and Ortiz, p. 385.

6. Weaver, p. 252.

7. Because many Native American communities have maintained fairly homogeneous populations within the boundaries of reservation lands, they, like other indigenous peoples throughout the world, express certain physiological traits, possibly genetic, within distinct geographical areas. This explains the blood/land connection, at least one aspect of it.

8. Deloria, *God is Red*, pp. 66-74.

9. Ibid., p. 57.

10. Ibid., p. 55.

11. Deloria, *Red Earth, White Lies*, p. 53.

12. Deloria, *God is Red*, p. 65.

13. Klein and Ackerman, pp. 5-7.

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World Community: Searching for a Global Cosmology

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Every culture in history has had a cosmology, a myth about origins. Such cosmologies provide societal and religious structure, ethics, and morals. Driven by mass communication, humanity is rapidly moving toward a world community. Individual cultures have been increasingly thrown into conflict, causing fear and defensive reactions. Global humanity needs what no culture has ever been without: a unifying cosmology. Many who are seeking fruitful dialogue between faith and science have become intimately involved in searching for such a cosmology. In the same spirit, others seek a more productive interfaith dialogue. Complex-systems approaches and process thinking may provide a model for both.

Paul sat at the kitchen table with his head in his hands. He and his wife Heather had decided, after several months of research, to home-school their two children, Dwight, aged 13, and Caroline, aged 10. On the table in front of him lay several textbooks that he had been assessing for their suitability as instructional aids for their science curriculum. All of them taught evolution, either openly or implied. How could they as parents tolerate a science curriculum for their children that seemingly taught that they were the accidental results of uncaring and purposeless forces of nature? He and Heather had carefully nurtured their children's love for Jesus and their Heavenly Father who created them in the divine image and likeness. The Biblical story of creation makes it clear that in the beginning God formed the world and made the animals and plants, and Adam and Eve, out of nothing, by God's spoken Word alone. Evolutionary science threatened everything they believed about human existence and divine creation.

In fact, the teaching of evolution and the bans on prayer in public schools had been powerful motivators in their decision to bring the children home to a more protected environment for their education. Ed, one of the members of Paul's law firm, served on the district school board and had recently been instrumental in blocking the teaching of creation science in the local public schools. Ed clearly expressed his concerns about his children being taught religious views to which he did not hold, views he felt were detrimental to his children's education. Paul liked Ed, but was frightened by Ed's belief that science is the only reliable source of knowledge.

Tired of worrying, Paul looked up at the clock and saw it was time to leave for work. He made a mental note that he needed to get on the Internet that evening and order books for the children from Focus on the Family's Odyssey series. When the children were very young, Heather had come across an article about a psychological study on the social and educational benefits of reading to children. They had carefully nurtured their children's love of reading ever since. On his way out the door, Paul grabbed his Lipitor and downed his daily dose. He had worked hard at exercise and diet but he still struggled with high cholesterol levels. Tomorrow he and Heather would try contacting a textbook company in the South they had heard produced evolution-free material for Christian schools. Surely there had to be an answer to their dilemma.

The above scenario is fictitious, but it is typically descriptive of the world of evangelical Christians in the United States.[1] Their faith rarely comes into conflict with physical, social, or medical science, or with technology. Evolutionary theory, however, even though well-supported by scientific evidence of many sorts, raises severe problems. On the other hand, those who have come to see evolution, not as just an acceptable scientific statement on origins, but a confirmation of their secular, nonreligious beliefs, see attempts to reject the teaching of evolution in schools as a threat to high-quality education.

Meanwhile, halfway around the world, extremists in the Arab world are making suicidal commitments to destroy the godless technological giant of the West that they feel threatens their beliefs, their way of life—indeed, their very existence. The secular, economic, and technologically driven society of the U.S. is anathema to the mystical, Allah-centered faith on which they base their daily lives. Ironically, science, the wayward child of medieval Christianity—itself the enemy of Islam—has challenged and frightened both Christian and Muslim alike in one form or another.[2] Why is there such fear and mistrust of other points of view, other ways of life?

A partial answer lies in the consideration of cosmologies. Every culture in recorded history, and presumably even before, has had a cosmology: a belief about the nature and origin of the world, including human beings, and about the existence of the divine.[3] These cosmologies are expressed, in part, through myths. Myth does not here mean a fictional story. It refers rather to the stories told from one generation to the next that define a culture's ontological understandings and provide direction for the development of ethics, morals, and the structure of the daily lives of individuals. These stories are associated with religious beliefs and ritual, and they are essential to the cohesiveness of the culture.[4]

Throughout history, the cosmologies and religions of various peoples have come into conflict with those of surrounding cultures. While cosmologies, myths, and religion hold a society together internally, externally they create an "us/them" mentality that breeds fear, mistrust, arrogance, hatred, and war. Religions, cultural groups, and nations with differing cosmologies often come into conflict.[5] For instance, the Western world, for the most part, now bases it cosmology on science.[6] The United States, however, sustains much internal conflict with this science-based cosmology, in part because of the phenomena of evangelical and fundamentalist Christianity, found in large numbers only in America, and also suffers external conflict with other cultures and faiths, such as Islam.[7]

Searching for a world-inclusive cosmology is a key aspiration of many who live and work at the interface of religion and science.

What makes this problem of conflicting cosmologies so extreme in the modern world is mass communication. Modern technology has brought with it heavy and unavoidable contact between diverse cultures, religions, and cosmologies. Air travel to any part of the world, audio and visual communication via phone, radio transmission, television, and, of course, the internet, have launched humanity inexorably toward becoming a world community. No cultural group is able to isolate itself, practically speaking, within tribal, village, or even national boundaries. Not even the family unit of the Evangelical Christian, the fundamentalist Muslim, or the Orthodox Jew can isolate itself from the influence of the outside world.

Meanwhile, science and technology, and even faith and religion, support economic and political opportunism that often works toward social and ecological destruction. Global humanity is in desperate need of what no community of humans has ever been without—a directive and unifying cosmology. They must find this cosmology together, or they may perish together. And the beautiful pale blue dot, suspended in the blackness of space, will continue on, without its remarkable inhabitants, who simply could not achieve their full potential for abundant life.

Of course, even though the prevailing wisdom of many experts says that this gloomy scenario should be taken seriously, many possible futures await the human species. Still, it cannot be denied that humans must face the realities of their global presence. They are no longer small bands of hunter-gathers. They dominate Earth in many diverse ways. They are a species conscious of themselves, their world, and reflective upon their own actions. They are able to understand and predict the behavior of matter and energy, to know that they may be laying the foundations of their own destruction, and that they may have the means to control their destiny. A global cosmology could create a consciousness of planetary wholeness that celebrates its own diversity, instead of an attitude of fragmentation that causes fear and mistrust of neighbors around the block, or around the planet.

Searching for a world-inclusive cosmology is a key aspiration of many who live and work at the interface of religion and science. The unique interdisciplinary nature of inquiries into the relationship between religion and science give these inquiries both a special advantage in working toward articulating a global cosmology and a predisposition to do so. There is also a need for positive global interfaith relations as an expression of the sense of an emerging world community. The cosmological difficulties experience by Paul, Heather, and Ed in the opening scenario, are centered on the evolution/creation debate, which is largely a American phenomenon; but the challenges of interfaith relations and of the interface between religion, science and technology exist worldwide.

Many thinkers, in their explorations of the relationship between religion and science, have developed categories of interaction that help provide useful clarification. Likewise, theologians and ethicists who specialize in interfaith understanding have also classified their efforts into categories. It is my position that these classifications might be enhanced and brought into fuller dialogue with world community and global cosmological thought by considering a new category for each set.

Beginning with the religion-and-science interface, two of the more clearly defined classifications are those of Ian Barbour, recent winner of the Templeton Prize for Progress in Religion, and John Haught, a theologian at Georgetown University. Their categories make use of two important concepts, namely, conflation and consonance.[8] Conflation is the merging of two different concepts into a single one, often done without conscious thought. I shall give two very different examples of this. One is the attempt of biblical literalists to promote scripture as accurate science, unconsciously buying into the societal assumption of science's validity. The other is the scientific materialists' unsupported atheistic conclusions drawn from the findings of science, with no notice taken of the implicit faith placed in the orderliness of the universe that makes it knowable. In both cases, there is a conflation of science and belief, a commingling of the two. Consonance, on the other hand, while retaining clarity of thought about the epistemologies of science and religion, looks for accord or agreement, fostering the development of novel and productive thinking about the single reality they may both be describing.

Although Haught's and Barbour's categories are quite similar, Haught's are the most alliterative, and hence the easiest to remember—each of his four categories begins with a "C". They also readily lend themselves to at least one outcome of this discussion, which is the suggestion of a possible fifth "C" category. I discuss this fifth "C" further on in this paper, but it is instructive first to examine briefly the initial four categories.

Haught's first category of approach to interface is *conflict*. This position is that science and religion cannot be reconciled and that conflict is perpetuated by the careless mixing of both science and religion with metaphysical and philosophical assumptions.

On the other hand, the second category, *contrast*, places science and religion in such separate spheres of knowing that not only is there no conflict between them, there is not even any method to compare them or to define any interface between them.

Haught's *contact* position, the third "C", seeks dialogue between science and religion, encouraging interaction and looking for consonance. It recognizes that science and religion are distinct ways of addressing ontological questions, yet they cannot be isolated since they both contribute to knowledge of the same reality.

> Contact proposes that scientific knowledge can broaden the horizon of religious faith and that the perspective of religious faith can deepen our understanding of the universe.[9]

Haught's fourth category is *confirmation*. This category reflects the historical and cultural roots of science found in the Christian worldview in the West. Science, for Haught, becomes the foundation for contextualizing the divine, which moves the universe onto the path of self-transcendence, or evolution. And Western Christian theology, influenced by Greek thought, is the foundation that permits science to think in terms of a rational, orderly world that can be understood by the human mind.

Scientific complexity theory and its possible relationship to process theology suggests that the consideration of a fifth "C" might be fruitful in approaching the relationship between science and religion. Paradigmatic shifts in theoretical science often bring about new ways of looking at the world and new philosophical and theological responses. There are many who believe that *complexity*, with its concepts of self-organization and emergence, will create yet another new understanding of the nature of reality.[10] As Bruce Weber, professor of biochemistry and co-author of *Darwinism Evolving*, has suggested in a recent workshop on Religion in the Age of Science, "The recently emerging sciences of complexity may well be giving rise to a new worldview." He writes further:

> Within an expanded naturalism, self-organizational principles, which may be deeply ingrained in nature, may work subtly with selective principles to produce emergence. The sources of order may be deep in nature giving the potential for evolution within freedom. This could have interesting theological implication.[11]

Many applications of complexity theory are in their infancy, and not all scientists believe they are all that revolutionary. But complexity appears to many to have great possibilities for new ontological statements and for "wholeness" thinking.[12] *Contact*, and even *confirmation* positions, while offering the possibility of productive dialogue, may not offer the capacity to encompass complex global relations. These two positions are satisfying to the human mind because they provide specific solutions and they have considerable operational value. But evolving a global cosmology that can bring diversity into wholeness without destroying uniqueness may require a much braver and far more unsettling approach. Complexity and chaos theory may provide just such a model.

Courage to be unsettled describes the requirements necessary to base a cosmology on complexity. The edge of chaos, replete with non-linearities and unactualized potentialities, is not a place where the human mind comfortably resides.[13] It is, however, a place balanced between vast possibilities and traditional thinking that could produce a new, emergent, and stable cosmology—one that could serve functionally in a wide range of cultures. Self-organization could be considered a model for understanding the apparently random synergies that produce entirely new and innovative solutions to old problems: thinking-outside-the-box strategies. Emergence encourages one to think of the possibility that humanity is creating an evolutionary transformation on the planet, a new worldwide community that will not be a sum of its old parts, but a wholly new entity. Finally, complexity theory takes into consideration the whole system and the intimate and intricate relationship of its parts, not in static sameness, but in dynamic process. This makes possible a philosophical connection to process theology which itself embraces temporal change and interconnected activity.[14]

Process thought takes the scientific concepts of evolution, complexity, and emergence, and applies them to new theological understandings of the transcendent divine and the operation of the immanent divine that could transform rather than homogenize the world's great wisdom traditions. Process theology, drawing on complexity theory, may have unique ability to work toward a globally inclusive cosmology. Both Haught and Barbour see evolutionary science as particularly capable of transforming the ways in which the divine is conceptualized, and both of them incorporate process thought and the implications of complexity theory into their discussions of science-and-religion interface.[15] Barbour's writes:

> Process philosophy has developed a systematic metaphysics that is consistent with the evolutionary, many-leveled view of nature....[16]

Understanding the universe in terms of spontaneous, synergistic, and self-organizing processes, rather than the artifactual results of linear and reducible processes, and in terms of emergent phenomena rather than static being, permits more holistic constructs within which to accommodate human diversity peacefully.

As mentioned above, those with ecumenical and interfaith concerns have also developed categories to express the ways in which different religions interact with one another. *Exclusivity* designates the "we're right and you're wrong" approach. *Inclusivity* retains the sense that "we're right" but acknowledges that other faiths contain some "truths." *Pluralism* allows that all approaches to divine understanding are equally acceptable. But each of these categories assumes a sense of a static, predefined faith position that restricts the possible solutions for interfaith dialogue. I suggest that *process* could be a fourth ecumenical and interfaith category, just as *complexity* could be a fifth science-and-religion interface category, thus opening up the possibilities for ecumenical, interfaith, and science-and-religion relations within a global cosmology.

Cosmologies and myths are intimately associated with the particular culture within which they developed. They evolve within the individual cultures through the experience of the members of those cultures. Even if the sciences of complexity and the theologies of process thinking could contribute to a consonant model for the cosmology of a world community, could such a model be transferred mythically—or transferred at all—to acceptance and usefulness in the daily lives of people around the globe? The objection might well be made that attempting to develop a global cosmology would, in effect, be imposing it on multiple cultures from the outside. This objection can be answered, however, if the world community itself becomes an "individual culture" and the new global cosmology is seen as developing organically out of this emerging community, brought into mythical form by the very people who are experi-

But evolving a global cosmology that can bring diversity into wholeness without destroying uniqueness may require a much braver and far more unsettling approach. Complexity and chaos theory may provide just such a model.

encing this final transition to world-sized community boundaries.

Standing in awe before both the lawfulness and the mystery of the universe through both science *and* faith can enhance the understanding of reality. Could Paul and Heather, and Ed as well, be encouraged to expand the number of possible solutions to their dilemmas through applications of more complex global viewpoints? Would the reduction of "us/them" thinking through more global cosmological approaches lessen their fears for their children? Could such thinking lessen the need for families, religions, and even nations to feel they must protect themselves from the perceived destructive cosmologies of others? Could they be encouraged to see themselves and others as just having differing understandings of the same complex reality?

The "us/them" mentality has traditionally found expression in a "protect and defend" mechanism. This is no less the case in science-and-religion and multi-religion interface. Rollo May stated it well in his book *Freedom and Destiny*:

> Whether scientist or religious, the dogmatic person is one who fears secretly that he must crystallize his beliefs or they will evaporate.... He fears this truth will disappear unless he puts a firm stockade around it.[17]

Complexity and process approaches to building the sense of world community could ultimately lessen the sense of "us/them" and build the sense of "we," bringing down the stockades like the Berlin Wall. This would allow members of various cultures and religions to venture out into a larger understanding of a global reality without jeopardizing their own stability. A great strength of viewing any system, human or otherwise, with an eye to complex dynamics is that there is no privileged perspective. Like six blind men describing the elephant by the way it feels, depending on where they are touching it, multiple views of reality serve better to describe the whole. In her article "Physics and Faith: The Luminous Web," Barbara Brown Taylor saw, as she was introduced to complexity theory, that it provided a new model for her life in community. She thought it was remarkably consonant with the biblical models she knew so well. She now argues that "the laws of complexity provide a third way between a literal reading of the Bible and blind chance operating in evolution."[18] Perhaps complexity theory could provide such consonance, as well, for peoples of various different denominations, faiths, and beliefs.

Finally, as it emerges, a global cosmology might inherently support the many efforts around the globe to address improvements in the human condition and to assure the survival of life on earth. In this light, it would first encourage equal opportunities for the contribution to human affairs of both men and women of all cultures and races. It would draw on the wisdom of the world's religions and cosmological myths, seeking not to conjoin them but to celebrate their unique spiritual descriptions of reality. It would include, but not aggrandize, the knowledge that scientific research contributes, and it would come to terms with technological advancements. It would encourage political and economic systems that seek to balance the needs of development, global commerce, and progress with strategies that seek to retain or restore planetary ecological health and promote human rights.[19] And finally, it would take into account the path of human development in relation to our technologies and other living things, and incorporate the attendant implications into a vision of humanity's future.[20]

Many believe there is a great potential in the philosophically related concepts of complex-systems thought and process theology to provide the foundations of a global cosmology for a world community. It remains to be seen, however, if this rich potential for a new myth, a new story for all of humanity, can be manifested in a manner that inspires and enriches the human experience of citizens of one tiny world suspended in the vastness and beauty of the universe.

Works cited:

Barbour, Ian G. *Religion and Science: Historical and Contemporary Issues.* San Francisco: HarperSanFrancisco, 1997.

Blaut, J. M. *The Colonizer's Model of the World: Geographical Diffusionism and Eurocentric History.* New York: The Guilford Press, 1993.

Coon, Carleton S. *Culture Wars and the Global Village.* Amherst, N.Y.: Prometheus Books, 2000.

Depew, David J., and Bruce H. Weber. *Darwinism Evolving: Systems Dynamics and the Genealogy of Natural Selection.* Cambridge, Mass.: MIT Press, 1997.

Genet, Russell. *The Chimpanzees Who Would Be Ants.* Huntington, N.Y.: Nova Science Publishers, 1997.

Gleick, James. *Chaos: Making a New Science.* New York: Penguin Books, 1987.

Haught, John F. *Science and Religion: From Conflict to Conversation.* New York: Paulist Press, 1995.

_____. *God After Darwin: A Theology of Evolution.* Boulder, Colo.: West View Press, 2000.

Larson, Edward J. *Summer For The Gods: The Scopes Trial and America's Continuing Debate Over Science And Religion.* Cambridge, Mass.: Harvard University Press, 2000.

Russell, Robert John, Nancey Murphy, and Arthur R. Peacocke. *Chaos and Complexity: Scientific Perspectives on Divine Action.* Vatican City State: Vatican Observatory Publications, 1995.

Taylor, Barbara Brown. "Physics and Faith: The Luminous Web." *Christian Century* 116, no. 17 (2-9 June 1999): 612-19.

Sharpe, Kevin. *Sleuthing the Divine: The Nexus of Science and Spirit.* Minneapolis: Fortress Press, 2000.

Weber, Bruce H. "Religion in an Age of Science." Keynote talk at a workshop presented at St. Andrew's Church, Fullerton, Cal. (10 March 2001), and St. Peter's Episcopal Church, Bennington, Vt. (1 December 2001).

Wertheim, Margaret. *The Pearly Gates of Cyberspace: A History of Space from Dante to the Internet.* New York: W. W. Norton, 1999.

Endnotes:

1. Although this is a fictional scenario, it is based on two evangelical families with whom I am well acquainted, and other friends who are unalterably opposed to teaching creation science or to allowing prayer in public schools.

2. Even though the rise of science is traditionally associated with the Renaissance, Wertheim points to the seeds of thought, sown in the Medieval period, that made scientific thought possible, the seeds of mind/body dualism.

3. I have adopted the use of the word "divine" from Kevin Sharpe. He chose the use of the word "divine" because he wanted "to look at the 'divine being,' God," without the limits set by religious traditions, bias, culture, or commonplace parlance" (p. x). Yet he is not entirely satisfied with this choice as there is a loss of some meaning and of strength from the use of the word God. Still, I feel its use has a tendency ecumenically "to open up" science and religion inquiries.

4. Blaut, in his discussion of the Western European myth of superiority that led to colonialism, gives a nice description of the part that Christianity, hence religion, played in this myth of superiority. Unfortunately, he then dismisses its relevance to his argument on the grounds that the argument is "grounded in faith and cannot be tested empirically" (p. 60). In one short sentence I believe he completely undoes an otherwise carefully researched and stated book-length argument by dismissing the importance of cultural myth, or cosmology. He also reveals the inherent modern Western bias that empirical evidence, or science, is the only reliable form of knowledge.

5. Anderson describes this "us/them" mentality in terms of "imagined communities" in a manner that sheds interesting light on the ingredients of nationalism.

6. To quote Wertheim: "Since the eighteenth-century Enlightenment we have lived in a culture that has been overwhelmingly dominated by material rather than spiritual concerns. In short, in the modern West we live in a profoundly materialist and physicalist age" (p. 31).

7. Larson's Pulitzer Prize winning book is a thorough and fascinating look at the "evolution/creation" debate in the United States. He carefully traces the history of evangelical and fundamentalist resistance to evolutionary theory, as well as its current status, using the Scopes "Monkey" trial as a focal point. I highly recommend this book to anyone wishing to understand this complex debate.

8. These categories and discussions of conflation and consonance can be found in Haught's *Science and Religion*, and Barbour's *Religion and Science*.

9. Haught, *Science and Religion*, p. 18.

10. Depew and Weber argue that an understanding of the dynamics of complex systems, applied through self-organization and emergence, can add new dimensions to the processes of evolutionary selection, without negating selection as a central tenant of Darwinian descent with modification. I believe this application of complexity theory provides a rich interpretive scientific structure for philosophical and ontological consideration.

11. Weber.

12. In 1993, twenty cross-disciplinary scholars were brought together by the Center for Theology and Natural Sciences in Berkeley, California, in conjunction with the Vatican Observatory, to explore the theological and philosophical implications of chaos and complexity as they concern the idea of divine action in the world. The proceedings of this landmark conference were published, and they provide an in-depth understanding of complexity and chaos from many perspectives.

13. Gleick sums up the nonlinear nature of chaos by stating that "twisted changeability makes nonlinearity hard to calculate [and nonintuitive], but it also creates rich kinds of behavior that never occur in linear systems [unactualized potentialities]" (p. 24; brackets mine). He also provides a comprehensible discussion of the incomprehensible subject of chaos.

14. Barbour, p. 285.

15. Haught has done an excellent job of incorporating both process and complexity thinking in *God after Darwin*. He is particularly insightful in his discussions of the problem of evil in a God-created universe.

16. Barbour, p. 284.

17. May, p. 202.

18. Taylor, p. 4.

19. Coon sees many of these efforts to improve the human condition naturally emerging out of a progressive trend from small tribes to a world community.

20. Genet gives an excellent history of the development of humanity's relation to "machine partners" and domesticates (plants and animals) in cultural evolutionary terms. He sees this historical insight as key to what the future might hold.

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Prigogine and Pannenberg: Theological and Scientific Perspectives on Contingency and Irreversibility

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The author demonstrates how Nobel Laureate Ilya Prigogine's pioneering work on dissipative structures and non-equilibrium thermodynamics might be used to answer theological questions about contingency and irreversibility that theologian Wolfhart Pannenberg posed to scientists twenty years ago. Prigogine's reformulation of classical dynamics and his mathematical model of irreversibility seem to corroborate Pannenberg's claim that natural phenomena must be both contingent and irreversible, if the Christain worldview is correct. The writings of Prigogine and Pannenberg provide an interesting example of the methodological difficulties encountered when comparing scientific and theological worldviews.

The influence of Protestant theologian Wolfhart Pannenberg stems largely from his daring attempts to bring theology into productive dialogue with branches of knowledge from which it is often considered estranged.[1] Although he is best known for his belief that the study of the Christian gospel cannot be divorced from the study of history,[2] Pannenberg's conviction that natural theology occupies an indispensable place in Christian scholarship is equally significant.

In many American universities, theology—the study of the world in the light of religious doctrine—has been replaced by religious studies—the study of religion in worldly terms.[3] God-of-the-Gaps theologies, which enjoyed limited popular resurgence following the development of quantum mechanics, were quickly recognized as futile attempts to resurrect an image of God that no longer enjoys the public's confidence.[4] More commonly, theologians today—and their scientific colleagues—take the position that theology and science cannot communicate one with the other because they are separate approaches to knowledge with incommensurable methodologies.[5] Pannenberg recognizes that, given the limitations of science's materialistic worldview, the alienation of science from theology is as unsatisfactory and unrealistic as theological attempts to dispute scientific evidence. Theology must develop a satisfactory means of engaging with science if it hopes to make relevant and credible assessments of twenty-first century science.

One of Pannenberg's boldest attempts to foster such engagement is his 1981 *Zygon* article, "Theological Questions to Scientists." There he poses the following questions:

> 1. Is it conceivable, in view of the importance of contingency in natural processes, to revise the principle of inertia or at least its interpretation?
>
> 2. Is the reality of nature to be understood as contingent, and are natural processes to be understood as irreversible?
>
> 3. Is there any equivalent in modern biology of the biblical notion of the divine spirit as the origin of life that transcends the limits of the organism?
>
> 4. Is there any positive relation conceivable of the concept of eternity to the spatiotemporal structure of the physical universe?

> 5. Is the Christian affirmation of an imminent end of this world that in some way invades the present somehow reconcilable with scientific extrapolations of the continuing existence of the universe for at least several billion years ahead?[6]

These questions pose a remarkable challenge to scientists and theologians. Pannenberg contends that Christian theology presumes affirmative answers to these questions, thereby explicitly opening itself to challenges from science. Nor does he fail to recognize what is at stake in his position:

> If the God of the Bible is the creator of the universe, then it is not possible to understand fully or even appropriately the processes of nature without any reference to that God. If, on the contrary, nature can be appropriately understood without reference to the God of the Bible, then that God cannot be creator of the universe, and consequently he cannot be truly God and be trusted as a source of moral teaching either.[7]

This statement insists that complementary communication between science and theology is not only possible, but that scientific and theological knowledge can, do, and must affect one another. Negative answers to any of the above questions would require Christians to rework or abandon several of their formative presuppositions. Pannenberg's questions identify areas in which theology must parley with science, if it is to move closer toward the Truth it seeks to understand.

The questions have received surprisingly little attention in the past twenty years. I know of just one unsatisfactory attempt to answer them.[8] In this paper, I attempt to answer Pannenberg's second question by examining the work of physical chemist Ilya Prigogine, whose work on irreversibility and non-equilibrium dynamics affirms Pannenberg's suppositions. It also addresses certain methodological problems encountered when any two theories with such radically different concerns, conventions, and histories as physical chemistry and philosophical theology are considered together. First, I shall explore the motivations behind Pannenberg's second question.

Pannenberg speculates at some length on the theological reasons for believing in an irreversible, contingent reality: "The theological claim of divine creation implies that the whole world is contingent."[9] Any model of the world in which the future is fully contained in the present is incompatible with the Christian doctrine of creation.[10] God's freedom must extend to all parts of the world, even to the creation of the world itself.[11]

As an outgrowth of this view, Pannenberg maintains the contingency not only of events, but of physical laws and properties as well. A contingent world cannot be governed by necessary physical laws and so cannot be completely predictable *a priori* from scientific reasoning. Pannenberg therefore uses the Humean term *regularities* to refer to physical laws. His use of the term follows from the assertion that every observed regular physical relationship depends upon God to sustain its validity. If the laws physics postulates as absolute admit for the contingency of actions, room still exists for meaningful divine action in the world. As Pannenberg writes in *Systematic Theology*:

> Theology, then...identifies the contingency of events both in detail and in the world as a whole as the expression of the creative activity of the Biblical God who acts in history. Even the rise of uniform processes that can be described in law formulas may then be seen by theology as a contingent positing of the creator. In this respect theology can appeal to the fact that cosmic processes characterized by the irreversibility of the flow of time, regular processes and scientific observation must have taken place for the first time in order to be then locked in [first instantiation].[12]

Scientific laws are manifestations of God's will to sustain order. Pannenberg goes further than Liberal Protestantism, since for him observed physical regularities imply a God who not only sustains the world but also acts purposefully within it.[13]

Pannenberg also urges scientists to acknowledge the contingency of future events.[14] Importantly, "the freedom of the God who acts in history finds expression in the contingency of historical events," [15] though this freedom exists on a level beyond human experience. For Pannenberg, historical contingency encourages a sense of wonder induced by an always-novel creation. His theology of historical revelation presupposes not only a unique creation but a unique history, gradually actualized as time progresses. Writing at a time when philosophers were arguing vehemently about the reality of time and tense,[16] Pannenberg recognized that time itself must be both unique and irreversible for traditional theologies to remain coherent.

Physical systems tend toward equilibrium. Rather than monotonically returning to equilibrium when perturbed, however, systems far from equilibrium often behave in unpredictable ways and form dissipative structures that spontaneously order themselves, exhibiting increasing complexity with time.

Irreversibility and contingency are, thus, absolute requirements of Pannenberg's theology. Despite his distinctive angle, Pannenberg is in line here with the mainstream of the Christian tradition.[17] A significant contribution to the Enlightenment's disillusionment with traditional Christianity stemmed from the rejection of these assumptions in favor of Newtonian determinism. Pannenberg's desire to reestablish them is, therefore, understandable; and Prigogine's insights into the nature of time should be welcomed by all who find classical determinism problematic.

Ilya Prigogine is best known for his investigation of non-equilibrium chemical systems, for which he won the Nobel Prize in 1977. Physical systems tend toward equilibrium, the point at which Gibbs free energy of reaction is minimized.[18] Rather than monotonically returning to equilibrium when perturbed, however, systems far from equilibrium often behave in unpredictable ways, Prigogine discovered, and form *dissipative structures* that spontaneously order themselves, exhibiting increasing complexity with time. Simple dissipative structures, such as the Brusselator and the Bénard instability, can be constructed in the laboratory.[19] These structures are characteristic of *open* thermodynamic systems, in which the second law of thermodynamics,

$$\Delta S \geq 0,$$

where ΔS represents the change in entropy of the system, does not apply. In the world of everyday experience, "closed" [20] systems, which do follow the second law, are extremely rare and almost always artificially constructed. Thus, the solar system can be seen as a massive dissipative structure, constantly energized and replenished by the sun.

Dissipative structures are formed when the thermodynamic stability of physical systems breaks down at certain bifurcation points far from equilibrium. Prigogine has shown that, because of apparent long-range correlations among particles, the law of large numbers breaks down at bifurcation points, so that the new configurations that systems adopt beyond these points are completely unpredictable.[21] For example, scientists can create Bénard cells in the lab, but they cannot predict whether the cells will circulate in clockwise or counterclockwise direction.

Interpreting these structures presents problems for classical mechanics, which treats the world as a system of rigid inertial bodies whose position and momenta at any time t_1 can be exactly calculated from precise knowledge of their position and momenta at any other time t_2 between zero and infinity. The time-symmetric, reversible, and deterministic world of classical dynamics conflicts with human experience.[22]

Ludwig Boltzmann attempted to give irreversibility a mathematical formulation[23] with his equation,

$$S = k \ln [\Omega],$$

where S represents entropy, k is Boltzmann's constant, and Ω represents the number of possible states for a given system. Boltzmann's theory, which has many applications and is still widely used today, seemed to derive irreversibility from dynamics by adopting statistical descriptions of physical processes. As Henri Poincaré and others pointed out, however, irreversibility cannot logically be deduced from a time-reversible system like classical dynamics.[24] For Boltzmann, entropy and irreversibility were merely manifestations of improbability and the impossibility of infinitely precise measurements. Given sufficient time, even the most complex system would return to its initial state.[25] Even after the advent of quantum mechanics, and despite criticisms by figures such as Max Planck,[26] some scientists, notably Einstein, remained enthralled with the idea of a deterministic world in which one could theoretically follow the trajectory of every atom and particle and describe all motion. While Einstein-Gibbs ensemble theory introduced statistical descriptions and correlations into quantum systems, it was developed only to mitigate the lack of infinitely exact measurements and still reflected belief in a deterministic world.

To demonstrate that determinism requires infinitely precise measurement, Prigogine uses the "baker transformation," [27] in which any two points, no matter how close initially, eventually diverge. Almost all physically real systems are described by non-integrable equations and, therefore, behave in ways that cannot be unpredicted, unless one has infinitely exact initial data and can carry out calculations with infinite precision.[28] The slightest change or uncertainty in initial conditions (including the use of coarse-graining in quantum mechanics) makes it impossible to determine the time-evolution of non-integrable systems.[29] Because of the Heisenberg Uncertainty Principle, even relatively simple problems like predicting rolls of the dice are insoluble, because the initial conditions of the system cannot be measured exactly.[30]

In contrast to most scientists, Prigogine has always believed that irreversibility is a real feature of the world, rather than a by-product of insufficient knowledge.[31] He has described time as a symmetry-breaking operator for many years, but until recently he could only cite human experience to justify the observed fact that humans live in a reality where systems tend toward equilibrium in the future rather than in the past.[32] Prigogine uses the Liouville operator to track the evolution of the density matrix ρ and the Perron-Frobenius operator to track probability distributions in systems with non-Hilbertian spectral representations. In order to get a complete spectral representation of the Perron-Frobenius and Liouville operators, one must go beyond Hilbert Space to consider complex eigenvalues. Even here, the spectral representation of the Perron-Frobenius operator remains irreducible. Priogine's extra-Hilbertian representations determine that the operators cannot be described in terms of classical trajectories, but only in terms of probability distributions.[33]

It follows that one must use statistical descriptions similar to the Gibbs-Einstein ensemble approach, not because of imprecision, but because the statistical description obtained with the operator formalism is no longer equivalent to the trajectory description fundamental to classical dynamics. Once one leaves Hilbert Space for the more robust Gelfand Space, the statistical description of systems is revealed as basic, while the trajectory description is merely a derivative formed from the superposition of Fourier plane waves with no inherent long-term fidelity. Even if exact measurements were possible, Hamiltonians with complex eigenvalues could only be accurately described using statistical methods.[34]

Irreversibility in natural systems, or Large Poincaré Systems (LPS),[35] ultimately results from imperfect correlations among particles. Particles that collide "remember" the interaction after impact. Correlations can subsist for long periods of time; but a deterministic world requires indefinite retention of all correlations, since a system's past is completely contained in its present state.

Because of Poincaré resonances, infinite correlations among atoms cannot occur.[36] In his three-body proof, Poincaré showed that frequencies in complex systems take the form

$$1/(n_1\omega_1 + n_2\omega_2),$$

where ω_1 and ω_2 represent the frequencies, and n_1nd n_2 represent nonvanishing integers, so that when

$$n_1\omega_1 + n_2\omega_2 = 0$$

the system is undefined.[37] These resonances are non-localized phenomena and so cannot be described by classical dynamics. Thus, for non-integrable systems the breakdown of long-range correlations points to the inadequacy of classical trajectories. Accurate description requires a statistical treatment, and even then cannot accommodate infinite correlations. Poincaré resonances, therefore, break time-symmetry and build the one-way nature of time into the nature of physical processes.

On the quantum level, Prigogine uses an analogous approach to integrate irreversibility into the traditional theory based on Schrödinger's equation. For quantum mechanical systems, leaving Hilbert Space is not sufficient to break the time-symmetric nature of the solutions to the Hamiltonians. Prigogine and his colleagues suggest a radical revision of the spectrometric basis of quantum mechanics inherited from Niels Bohr's conception of the atom. Prigogine says that he does "solve the Liouville eigenvalue problem for LPS in the context of more general function spaces," [38] but the consequences of breaking time-symmetry are extreme:

- The eigenvalues of the Liouville operator are no longer differences between the eigenvalues of the Hamiltonian, which are obtained from the Schrödinger equation. Therefore, the Ritz-Rydberg principle is violated, whereby the systems are no longer integrable and the approach to equilibrium is possible.

- The quantum superposition principle associated with the linearity of the Schrödinger equation is violated.

- The eigenfunctions of the Liouville operator are not expressed in terms of probability amplitudes or wave functions, but rather in terms of probabilities proper.[39]

Prigogine's theory, therefore, shows that human inability to predict the evolution of non-integrable systems results not from a lack of information, but from the fundamentally statistical nature of large systems. Time's irreversibility prevents an exact, non-statistical deduction of future states from knowledge of present conditions. According to Prigogine, therefore, events in the universe are fundamentally irreversible as well as contingent—no being, even an infinitely intelligent "Laplacian demon," can predict the future, unless its vision transcends time itself.[40]

If classical and quantum dynamics have been empirically discredited, perhaps the metaphysical belief in universal simplicity and intelligibility that inspired them should also be revised.

Pannenberg's second question has been answered affirmatively by a Nobel Laureate. Pannenberg's own speculation on the second question could have been written by Prigogine: "contingency and irreversibility may have their common root [in the irreversibility of time]." [41] Pannenberg and Prigogine agree that the world is irreversible, and that the future is not wholly determined by the present.

Despite this conformance, Prigogine and Pannenberg's claims are built on very different metaphysical and methodological assumptions, and this underlying baggage must be unpacked to understand how their views relate in detail. Prigogine's work has been confined to the scientific realm of non-equilibrium systems. He employs the highly technical, strictly phenomenological jargon of professional physics, which cannot address the logical necessity of either physical laws or the universe itself. He considers his new irreversible dynamics to be a better empirical formulation of entropy and, thus, a truer representation of reality.[42] He recognizes that knowledge requires a knower but believes that knowledge is "both objective and participatory," [43] for although scientists draw inferences from regularities, they are not themselves responsible for creating the regularities,[44] even though regularities "do not correspond to a logical or epistemological truth." [45] Many scientists still accept this myth of objectivity, but even those who applaud the empiricism of academic science must acknowledge the need for nonscientific presuppositions.[46] Scientists, of course, have the right to draw epistemelogical or metaphysical conclusions from their work,[47] as long as they recognize that such conclusions are not scientifically warranted.[48] Yet if classical and quantum dynamics have been empirically discredited, perhaps the metaphysical belief in universal simplicity and intelligibility that inspired them should also be revised.

Pannenberg shares Prigogine's belief in a reality that is contingent and irreversible, but his grounds for doing so stem from the *a priori* givenness of God, rather than the *a posteriori* evidence of experiments. For Pannenberg, theology augments other disciplines by providing insight into their distinctly personal aspects.[49] Physics, thus, remains incomplete without the complementary insight that theology provides. Still, theology's dependence on personal revelation makes constructing statements recognized as universally applicable very difficult.

Prigogine points out that our world is an open system in which entropy and irreversibility drive increasing complexity and order. The development of life on earth, the evolution of society and culture, and even the observed universe are all large-scale dissipative structures made possible by time's irreversibility.[50] The alternative to contingent reality would be a changeless existence with no place for a concept of the human being.

Pannenberg agrees with Prigogine that entropy is a mixed blessing, giving rise not only to creativity and orderly existence, but also to destruction and physical finitude.[51]

Prigogine and Pannenberg work from very different presuppositions; and though they have certainly not reached intellectual common ground, they share intellectual office space on the question of physical contingency.

However, while theology can directly explore the intuitive perception of entropy in the world, science cannot cope with ideas that are not identified and reified via testable mathematical relationships. This methodological weakness motivates scientists' perennial attempts to deny entropy and irreversibility and has motivated Prigogine's work to reinvent dynamics. As a human, he knows entropy must be real; yet as a scientist, he cannot understand entropy until it has been mathematically described in terms of physical data. Pannenberg's arguments contain no such tension. Prigogine and Pannenberg work from very different presuppositions; and though they have certainly not reached intellectual common ground, they share intellectual office space on the question of physical contingency.

Pannenberg and Prigogine do disagree in important areas; the most important disagreement stems from Pannenberg's theology of history.[52] For Pannenberg, true existence extends beyond the present and resonates throughout time. Human existence is only partially contained in the present, since events are inseparable from their teleological significance and antecedent conditions.[53] God's ultimate purpose for creation can be understood only at the *eschaton*, when history will be seen in its totality. This purpose, however, has been revealed proleptically through the Resurrection for the benefit of all humanity. Finally, Pannenberg maintains that the future retroactively reformulates and reconstitutes the present in light of God's eschatological goal. The future's contingency allows creation to enter freely into an open future and allows God the freedom to sustain creation and incorporate it into the divine eschatological end.[54]

This retroactive future contradicts Prigogine's assertion that information can flow only in one direction:

A time-reversible world would be an unknowable world. Knowledge presupposes that the world affects us and our instruments...and that this interaction creates a difference between past and future.[55]

While God's retroactivity is one of the most difficult areas in Pannenberg's theology, theories of retroactive causation can be formulated in realist causal philosophies.[56] Perhaps Pannenberg must endure criticism with the hope that future scholarship will retroactively vindicate his present position.[57]

Another conflict in Prigogine and Pannenberg's thought arises from their different understandings of time's relation to reality. Prigogine believes time, or at least irreversible processes, is endless and fundamental to reality.[58] Abandoning *creatio ex nihilo* for *creatio ex temporis*, Prigogine endorses the Tyron-Brout "free lunch" cosmology, in which an initial instability creates a one-way universe where contrasting gravitational and matter fields provide structural integrity.[59] In contrast, Pannenberg's view of time is more traditional.[60] He accepts that the universe and time have a beginning in the finite past,[61] but rejects speculation about time preceding existence as incoherent circular reasoning.[62] Instead, he suggests that eternity simultaneously borders and is in contact with every moment of time, including its spatiotemporal beginning. Pannenberg describes eternity as the vantage point from which all of time can be viewed simultaneously.

Prigogine admits that his cosmological theories are more speculation than science.[63] Though theology is capable of tackling non-observable problems, Pannenberg's speculations about cosmology are also inconclusive. Ultimately, Pannenberg's theology and Prigogine's physics lead to metaphysical beliefs about reality beyond the observed spatiotemporal universe that are not strictly compatible, but within the universe much less tension between Pannenberg's and Prigogine's theories exist. In particular, Prigogine's hunch that fields are ontologically basic may have useful bearing on Pannenberg's theory of the Spirit as a force field or his concept of eternity. These questions suggest that further examination of Prigogine's work in the light of Pannenberg's fourth question to scientists may prove useful.

Despite the differences outlined above, Prigogine's affirmative answer to Pannenberg's second question highlights the way in which science can bolster theological hypotheses. On the other hand, their disagreements demonstrate science's reliance on a subjective, interpretive framework. Discussions regarding cosmological models emphasize this dependence; theology's more robust metaphysical system provides a firmer ground for speculation than does science's empiricism.

Like most scientists, Prigogine believes that the mathematical relationships he has discovered are somehow ontologically basic and, therefore, the key to understanding the universe and its origin. Extrapolations of this sort invariably fail to consider the personal aspects of reality and so cannot form truly holistic worldviews. Theological insight may reduce this deficit in science, though scientific evidence can challenge or confirm the speculations of theologians about how the world works.

Prigogine's program is part of a growing movement across disciplines to redefine how physical processes are conceptualized. He advocates steering the "narrow path" that rejects both Newtonian determinism and a chaotic, meaningless universe.[64] While physical laws are constructed by human minds, admitting that Prigogine believes these laws are neither arbitrary inventions nor capable of bringing all natural phenomenon into a rational framework of regularities. Regular processes accessible to human thought do exist in the world. Prigogine's philosophical conclusions here integrate well with Pannenberg's theology.

Similarly, Pannenberg's work may be seen as a return to a contingent natural theology in which humans are justified in seeing God's handiwork in phenomena such as physical regularities and complex organic structures, but are barred from the ability to understand the world completely. Such complete understanding would require a knowledge that transcends the limits of temporal being. Thus, the world reflects God's transcendence without invalidating, for instance, Ian Markham's correct claim that belief in God necessitates belief in a universal truth.[65]

Perhaps Genesis 1:26-30 provides a Biblical analog. God has given humanity reason and the power to subdue the world and all the things in it. Human dominion over the earth is manifest in the (God-given) ability to understand and manipulate the elements of the created order. The world is not simple, but humans can identify and systematize elements of the world that can, for practical purposes, be conceived as simple (e.g., the action of a lever). Contemporary understanding of the world, though partial, is sufficient to show that complete knowledge of the world is humanly (though not divinely) impossible.

The Incarnation gives meaning and purpose to humanity's dominion in the world. As Pannenberg has written, God has proleptically revealed God's future aim in the present through the Resurrection. The insight gained from this revelation provides teleological purpose to Christians' ability to understand the world, a purpose that requires, for its ultimate realization, input from both theological reflection and rational scientific attempts to uncover rationality in the world.

Works cited:

Albert, David Z. *Time and Chance.* Cambridge, Mass.: Harvard University Press, 2000.

Andison, M. L. *The Creative Mind.* New York: Philosophical Library, 1946.

Antoniou, Ioannis, Ilya Prigogine, V. Sadovnichii, and S. A. Shkarin. "Time Operator for Diffusion." *Chaos, Solitons, and Fractals* 11 no. 4 (March 2000): 465-77.

Aquinas, Thomas. *Summa Theologiae.*

Cartwright, Nancy. *The Dappled World: A Study of the Boundaries of Science.* Cambridge: Cambridge University Press. 2000.

Christiansen, Ferrel. "Time's Error: Is Time's Asymmetry Extrinsic?" *Erkenntnis* 26 (March, 1987): 231-48.

Denbigh, K. "How Subjective is Entropy?" *Chemistry in Britain* 17 (1981): 168-85.

Dulles, Avery. "Pannenberg on Revelation and Faith." In *The Theology of Wolfhart Pannenberg: Twelve American Critiques,* ed. by Carl E. Braaten and Philip Chayton, 169-87. Minneapolis: Augsburg Publishing House, 1988.

Flew, Anthony. "Scientific versus Historical Evidence." In *Miracles,* ed. by Richard Swinburn, 97-102. London: Collier Macmillan Publishers, 1989.

Hefner, Philip. "The Role of Science in Pannenberg's Theological Thinking." In *Beginning with the End: God, Science, and Wolfhart Pannenberg,* ed. by Carol R. Albright, Carol R. Haugen and J. Haugen, 97-115. Chicago: Open Court Press, 1997.

Lakatos, Imre. *Proofs and Refutations: The Logic of Mathematical Discovery.* Cambridge: Cambridge University Press, 1977.

Lewis, David. "Causation." In *Causation,* ed. by Ernest Sosa and Michael Tooley, 193-204. Oxford: Oxford University Press, 1993.

Markham, Ian S. *Truth and the Reality of God.* Edinburgh: T. & T. Clark, 1998.

Maxwell, Nicholas. *The Comprehensibility of the Universe: A New Conception of Science.* New York: Oxford University Press, 1998.

Midgely, Mary. *Science as Salvation: A Modern Myth and Its Meaning*. London: Routledge, 1992.

Misra, Baidyanath. "Nonequilibrium Entropy, Lyapounov variables, and ergodic properties of classical systems." *Proceedings of the National Academy of Sciences* 75 (1978): 1627-31.

Mellor, David H. *Real Time*. Cambridge: Cambridge University Press, 1981.

Nicolis, Gregoire, and Ilya Prigogine. *Self-organization in Non-equilibrium Systems*. New York: Wiley, 1977.

Paley, William. *Natural Theology; or Evidence of the Existence and Attributes of the Deity Collected from the Appearances of Nature*. London, 1802.

Pannenberg, Wolfhart. *Anthropology in Theological Perspective*. Trans. Matthew J. O'Connell. Philadelphia: Westminster, 1985.

______. Letter to Timothy Bradshaw, 12 July 1983. In *Trinity and Ontology: A Comparative Study of the Theologies of Karl Barth and Wolfhart Pannenberg*, by Tomothy Bradshaw, 402. Lewiston, N.Y.: Edwin Mellen Press, 1988.

______. *Metaphysics and the Idea of God*. Trans. Philip Clayton. Edinburgh: T. & T. Clark, 1990.

______. "Contingency and Natural Law." Trans. Wilhelm C. Linss. In *Toward a Theology of Nature: Essays on Science and Faith*, ed. by Ted Peters, 72-122. Louisville, Ky.: Westminster John Knox Press, 1993.

______. "The Doctrine of the Spirit and the Task of a Theology of Nature." In *Towards a Theology of Nature: Essays on Science and Faith*, ed. by Ted Peters, 123-37. Louisville, Ky.: Westminster John Knox Press, 1993.

______. "Spirit and Energy: The Phenomenology of Teilhard de Chardin." in *Towards a Theology of Nature: Essays on Science and Faith*, ed. by Ted Peters, 138-47. Louisville, Ky.: Westminster John Knox Press, 1993.

______. *Systematic Theology*. 3 volumes. Trans. Geoffrey W. Bromley. Edinburgh: T. & T. Clark, 1991-1998.

______. *Theology and the Philosophy of Science*. Trans. Francis McDonagh. London: Darton, Longman, & Todd, 1976.

______. "Theological Questions to Scientists." *Zygon* 16 (March 1981): 65-77.

______. "The Doctrine of Creation in Modern Science." In *Cosmos as Creation: Theology and Science in Consonance*, ed. by Ted Peters, 152-76. Nashville: Abingdon Press, 1989.

______. *Towards a Theology of Nature: Essays on Science and Faith*. Ed. Ted Peters. Louisville, Ky.: Westminster John Knox Press, 1993.

Pannenberg, Wolfhart, Rolf Rendtorff, Trutz Rendtorff, and Ulrich Wilkens. *Revelation as History*. Trans. David Granskou. New York: MacMillan, 1968. [Originally published in 1961 as *Offenbarung als Geschichte*].

Petrosky, T., and Ilya Prigogine. "The Liouville Space Extension of Quantum Mechanics." *Advances in Chemical Physics* 99 (1997): 1-120.

______. "Poincaré Resonances and the Extension of Classical Dynamics." *Chaos, Solitons, and Fractals* 7 no. 4 (April 1996), 441-97.

______. "Poincaré Resonances and the Limits of Quantum Mechanics." *Physics Letters A* 182 no. 1 (November 1993): 5-15.

______. "Quantum Chaos, Complex Spectral Representations, and Time-symmetry Breaking." *Chaos, Solitons, and Fractals* 4 no. 3 (March 1994): 311-59.

______. "Thermodynamic Limit, Hilbert Space and Breaking of Time Symmetry." *Chaos, Solitons, and Fractals* 11 no. 1–3 (January–March 2000): 373-82.

Planck, Max. *Treatise on Thermodynamics*. New York: Dover Publications, 1945.

Poincaré, Henri. *Leçons de Thermodynamique*. Ed. J. Blondin. Paris: Hermann, 1892.

______. "La mécanique et l'expérience." *Revue Métaphysique et de Morale* 1 (1893): 534-37.

______. *New Methods of Celestial Mechanics*. Ed. Daniel Goroff. Woodbury, N.Y.: American Institute of Physics Press, 1993 [1893].

______. *Science and Method*. Trans. Francis Maitland. Bristol: Thoemmes Press, 1996 [1914].

Pollard, William G. *Chance and Providence: God's Action in a World Governed by Scientific Law*. London: Faber and Faber, 1958.

Prigogine, Ilya. *From Being to Becoming: Time and Complexity in the Physical Sciences*. San Francisco: W. H. Freeman, 1980.

______. *The End of Certainty*. London: Free Press, 1997.

______. "Laws of Nature, Probability, and Time Symmetry Breaking." *Physica A* 263 no. 1–4 (February 1, 1999): 528-39.

Prigogine, Ilya, and Isabelle Stengers. *Order Out of Chaos: Man's New Dialogue with Nature*. New York: Bantam Books, 1984.

Russell, Robert John. "T = 0: Is it Theologically Significant?" In *Religion and Science: History, Method, Dialogue*, ed. by W. Mark Richardson and Wesley J. Wildman, 201-24. London: Routledge, 1996.

Schleiermacher, F. D. E. *On Religion: Speeches to Its Cultured Despisers*. Trans. Richard Crouter. Cambridge: Cambridge University Press, 1988.

Stannard, Russell. "The Moral Maze." Radio broadcast, January 27, 2001. London: BBC Radio 4.

______. *Science and Wonders*. London: Faber and Faber, 1998.

Szendre, Eric V. "Bergson, Prigogine, and the Rediscovery of Time." *Process Studies* 18 (Fall 1989): 181-93.

Tipler, Frank. "The Omega Point as *Eschaton*: Answers to Pannenberg's Questions to Scientists." *Zygon* 24 (June 1989): 217-53.

Tooley, Michael. "Causation: Reduction versus Realism." In *Causation*, ed. by Ernest Sosa and Michael Tooley, 172-192. Oxford: Oxford University Press, 1993.

Ward, Keith. *Religion and Creation*. Oxford: Oxford University Press, 1996.

Whitehead, Alfred North. *Process and Reality: An Essay in Cosmology*. Cambridge: Cambridge University Press, 1929.

Wiener, Norbert. *Cybernetics; or, Control and Communication in the Animal and the Machine*. New York: MIT Press, 1961.

Wiles, Maurice. *God's Action in the World*. The Bampton Lectures, 1986. London: Xpress Reprints, 1993.

Endnotes:

1. For a good summary of Pannenberg's theological program see Hefner.

2. First articulated in Pannenberg et al., *Revelation as History*. Pannenberg's theology was in part a reaction to the separation of history and theology championed by Bultmann's demythologizing agenda.

3. A similar shift occurred in early nineteenth-century Europe. See Schleiermacher.

4. For a contemporary exponent of this theological approach, first popularized in Paley, see Pollard. Contemporary quantum mechanical theories have further discredited Pollard's concept of divine action.

5. The emergence of 'religious studies' as a social science can be seen as one attempt to bridge this communication gap. For philosophical and theological expressions of this point see Midgely, pp. 32–51, and Stannard, *The Moral Maze*, respectively.

6. Pannenberg, "Theological Questions to Scientists," reprinted in his *Towards a Theology of Nature*, pp. 15–28.

7. Ibid. Here Pannenberg clearly reflects his Barthian dialectical heritage.

8. See Tipler.

9. Pannenberg, "The Doctrine of Creation in Modern Science," pp. 29–49. See also Pannenberg, *Systematic Theology*, pp. 69–70.

10. Pannenberg, "Contingency and Natural Law." For Pannenberg "contingent" describes phenomena that are not logically necessary.

11. Pannenberg, Letter to T. Bradshaw. Pannenberg considers the world's existence to be a contingent feature of its history.

12. Pannenberg, *Systematic Theology*, vol. 2, pp. 70–71.

13. Liberal Protestants often limit divine agency to God's sustaining providence. In his 1986 Bampton Lectures, Maurice Wiles concludes that "the God who...plays an active role in the world may not be an appropriate description of the God whose agency I have been seeking to describe" (p. 108). This approach to science and religion concedes all authority over observable phenomena to science, relegating religion to an abstract metaphysical belief. Theologies attempting to remove perceived conflicts between science and religion by disallowing purposeful divine action are ultimately retreats to Deism, the rise of which has paradoxically been a principal source of Christianity's decline in temporal influence over the past three centuries.

14. Pannenberg, *Systematic Theology*, vol. 2, pp. 99–100.

15. Pannenberg, *Systematic Theology*, vol. 1, p. 418.

16. See Mellor.

17. Ward, pp. 230–36 and references therein.

18. *Ie.* $\Delta G = \Delta H - T\Delta S$. As suggested by the notation, free energy is a relative quantity; ΔG has standard values with 0 assigned to the lowest energy states of a give system. Free energy minima characterize thermodynamic equilibria. In practice, high activation energies often favor kinetic equilibria (roughly equivalent to minima in ΔH, the enthalpy or heat energy), which may be a locally stable state distinct from true thermodynamic equilibria.

19. For brief descriptions of the Bénard instability and the Brusselator, see Prigogine and Stengers, pp. 142–44 and 146–153, respectively. For greater detail see Nicolis and Prigogine.

20. While many works on thermodynamics used "closed" to describe systems permeable to energy but not matter, this essay follows Prigogine in using "closed" as synonymous with "isolated"—impermeable to both energy and matter.

21. *Ie.*, the Poisson Distribution; for a definition and relevant discussion see Prigogine, *From Being to Becoming*, pp. 133–38.

22. See Albert, pp. 1–21.

23. Boltzmann's equation was derived from studying systems of dilute gases.

24. Poincaré, "La mécanique et l'expérience," and *Leçons de Thermodynamique*. Cf. Prigogine and Stengers, pp. 243–46; and Prigogine, *From Being to Becoming*, pp. 155–159.

25. This is the Poincaré Recurrence Theorem, developed in the references in the previous note and further explored in Misra, p. 1629. Technically, a system will only become arbitrarily close to its initial state given non-infinite time. After Poincaré's criticism, Boltzmann's theory was open to the charge that irreversibility of the universe is a function of humans' short lifespans and practical barriers to infinitely precise measurement.

26. Planck, p. 106.

27. Prigogine, *From Being to Becoming*, pp. 187–191, 219–231.

28. This is Poincaré's famous proof of the three-body problem; see his *New Methods in Celestial Mechanics*. Non-integrable systems correspond to quantum mechanical systems with continuous spectra.

29. This result follows from the Center Theorem (1895) of Aleksandr Lyapounov, which shows in just what sense the exact solution to a system of equations that approximates a physical system can be viewed as an approximate solution to the system of equations that exactly describes the system.

30. This example was suggested by Poincaré in *Science and Method*, ch. 4.

31. For Prigogine's motivations see Prigogine and Stengers, p. 10; and Prigogine, *The End of Certainty*, p. 72; for a contrary view see Denbigh.

32. Prigogine's group proposes a detailed mathematical formulation of the time operator in Antoniou et al.

33. For an unpacking of this somewhat dense paragraph, see Prigogine, *End of Certainty*, pp. 89–128.

34. For a detailed formulation of this theory see Petrosky and Prigogine, "Thermodynamic Limit, Hilbert Space and Breaking of Time Symmetry." For a less technical account see Prigogine, "Laws of Nature, Probability, and Time Symmetry Breaking."

35. Systems large enough to justify neglecting boundary effects; see Prigogine, *End of Certainty*, pp. 158–59.

36. Prigogine's earlier work refers to these resonances as "Poincaré catastrophes"; see Prigogine, *From Being to Becoming*, pp. 30–43, 191–194; cf. Prigogine, *End of Certainty*, pp. 39–43. For more detail, see Petrosky and Prigogine, "Poincaré Resonances and the Extension of Classical Dynamics."

37. Prigogine, *End of Certainty*, p. 40.

38. Ibid., p. 146.

39. Ibid., p. 149; for a rigorous presentation see Petrosky and Prigogine, "Quantum Chaos"; Petrosky and Prigogine, "Poincaré Resonances"; and Petrosky and Prigogine, "The Liouville Space Extension."

40. Cf. Prigogine and Stengers, pp. 271–72.

41. Pannenberg, "Theological Questions to Scientists," p. 22.

42. Some have critiqued Prigogine's work for taking an intuitive view of time as a starting point coupled with a misplaced belief in scientific objectivity (cf. Szendrei). For the suggestion that time depends on intuitive human perception rather than supposed physical reality see Christensen.

43. Prigogine and Stengers, p. 299.

44. Ibid., p. 5; Prigogine's concept of objectivity is critiqued in Szendrei, "Rediscovery of Time." For an argument that scientists actually do create regularities by setting up artificial environments, see Cartwright, pp. 1–19, 49–102.

45. Prigogine and Stengers, p. 300.

46. Eg., the isotropy, simplicity, and intelligibility of the physical world and the power of mathematics to describe it. See Maxwell, pp. 36–74.

47. As scientific books written for the general public almost invariably do. Michael Poole calls this the "Last Chapter phenomenon," in Stannard, *Science and Wonders*, p. 195.

48. As Imre Lakatos points out, facts themselves do not suggest ideas; a conceptual framework is necessary for induction; for a discussion of "the myth of induction" see Lakatos, p. 73.

49. Hefner, p. 98; cf. Pannenberg, *Anthropology*, p. 59.

50. Prigogine and Stengers, pp. 176, 190–91, 203–7.

51. Pannenberg, "Contingency and Natural Law," pp. 98–99; see also *Systematic Theology*, vol. 2, p. 71, n. 174.

52. For an explication see Panenberg, *Systematic Theology*, vol. 1, pp. 243–57. For a concise critical account of Pannenberg's theology of history see Dulles.

53. Pannenberg, "Contingency and Natural Law," pp. 84–5 and surrounding discussion.

54. More specifically, for Pannenberg, the Holy Spirit continuously reconstitutes the present in light of the future. Pannenberg identifies the Holy Spirit with his theological field concept. See his essays "The Doctrine of the Spirit," and "Spirit and Energy." Pannenberg's spirit theology is controversial and not widely accepted.

55. Prigogine, *End of Certainty*, p. 153; cf. Wiener, *Cybernetics*, quoted in Prigogine and Stengers, p. 296.

56. For a discussion (especially regarding Wiener's hypothesis), see Tooley, p. 181. For

speculation on backwards causation, see Lewis.

57. For Pannenberg's explanation and defense of retroactive causation see Pannenberg, "Contingency and Natural Law," pp. 105-108.

58. Ie., that "time precedes existence"; see Prigogine, *End of Certainty*, pp. 163-66.

59. Prigogine, *End of Certainty*, p. 179 and surrounding discussion.

60. For details of Pannenberg's cosmological views see his *Systematic Theology*, vol. 2, 7.III para. 2; and "Contingency and Natural Law," pp. 99ff.

61. Prigogine agrees with Thomas Aquinas, who famously argued that whether the world has a beginning or not is theologically irrelevant; see Aquinas, I 46.1, quoted in Pannenberg, *Systematic Theology*, vol. 2, p. 149.

62. Pannenberg, *Metaphysics and the Idea of God*, pp. 61ff. Pannenberg's criticism is directed at Whiteheadian Process Theology, with which Prigogine sympathizes.

63. Prigogine, *End of Certainty*, p. 166.

64. Ibid., ch. 9.

65. See Markham.

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Science and Theology: A Working Synthesis

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Theologians and scientists, working independently, have provided worldviews that lead to questions about the meaning of existence and human life. When these disciplines interact, opportunity exists for more profound insight. Two individuals, Johannes Kepler in the sixteenth century and Pierre Teilhard de Chardin in the twentieth, attempted theological reconstructions based on revolutionary theories of their eras. Informed by a fierce faith in God and a rigorous pursuit of truth derived from the scientific method, their attempts at synthesizing these fields led to results that were unexpected, even unwanted. Yet they provide lessons in the present age for interpretations of the new discoveries and the responsibility of humankind to play an active role in the modern creation story.

Science and Theology—the Synthesis

In a mysterious and complex world, theologians and scientists deeply devoted to the implications of the meaning of human existence offer explanations related to an understanding of creation. Yet humans, as a thinking species, have come to realize that there are no simple answers. Nature gives up her secrets slowly, and insights that prove the most fruitful need the cross-fertilization of both disciplines in order to arrive at a more complete world-view.

Two revolutionary developments in the field of modern science have profoundly affected an understanding of the cosmic question of human existence. In 1543, Nicholas Copernicus published *De Revolutionibus*, in which he introduced to the modern world the concept that the sun, not the earth, was at the center of the then-known universe. Three centuries later, Charles Darwin published *On the Origin of Species* in 1859, and *Descent of Man* in 1871, which proposed natural selection as the process that produced all living organisms, including human beings.

These developments released a vast amount of intellectual energy. Out of the turmoil of intense debate came a deeper understanding of the science involved, more profound theological insights into the secrets of creation, and a fuller appreciation for the complexity of existence. Two individuals, Johannes Kepler in the sixteenth century and Pierre Teilhard de Chardin in the twentieth, combined a fierce devotion to God with a profound appreciation of the wonders of nature to attempt to understand the natural world.

The Failed Seminarian and the New Science

Johannes Kepler was born in 1571, 28 years after the publication of Copernicus' *De Revolutionibus*. The sun's central location in the universe was not taken seriously until, as a young professor of mathematics, Kepler became one of the first to espouse this theory in the 1590s as a real description of nature.

As a Lutheran seminarian, Kepler developed a reputation for his brilliance as a mathematician and for his propensity to accept radical views on topics as diverse as the structure of the universe and the value of Calvinism.[1] He was surprised, only a few weeks prior to ordination, to be recommended by his seminary professors for a position teaching mathematics and natural philosophy. Though this recommendation was probably motivated by the desire to keep his radical views hidden within the academic community, he reluctantly accepted and his career as a scientist began.

To Kepler, the fact that the sun was the center of the universe made perfect sense. While he found it to be a mathematically simpler means to understand the movement of the planets, he saw greater importance in the fact that the "sun must be the center of the world because he is the symbol of God the Father, the source of light and heat, the generator of the force which drives the planets in their orbits."[2] So for this "metaphysical reason,"[3] to use Kepler's words, the new and radical Copernican idea became the operating principle of his theology.

The idea for his cosmology is said to have struck him in the middle of a classroom lecture. Already known for his mumbling and confusing lecture style, his words must have thoroughly perplexed his students that day! What was intuitively obvious to Kepler was a cosmology based on three known concepts of natural theology. First, he was in complete agreement with the Aristotelian idea that planetary orbits must be perfect circles to reflect God's perfection. Second, for his "metaphysical reason", the sun was the center of the cosmos. Third, was his startling new observation of the uncanny agreement between the six known planets and the geometrical anomaly that there are only five possible perfect solids—three-dimensional objects whose surfaces are all identical geometric planes (the cube, for example). This concept was crucial to his cosmology, because a perfect solid has the unique property of allowing a sphere, the three-dimensional extension of a circular planetary orbit, to surround it such that each of the solid's corners touch the circumscribed sphere. A complete set of perfect solids and their circumscribed spheres, scaled so as to nest tightly inside one another, yielded a ratio of sizes that Kepler hoped to prove exactly matched the ratio of the sizes of the planetary orbits. Perfect circles separated by the geometry of perfect solids: Never had the language of the cosmos—the common language of Creator and man—spoken so clearly of God's perfection.

Kepler's cosmology was firmly rooted in his ardent pursuit of theology and based on the best and most modern principles of the science of the day. The mind of the Creator could be read as that of a Perfect Geometer.

For theology, God's creation was seen to be more complicated and subtle than indicated by the artificial perfection of earlier models. The benefit of the synergy of these two fields to science was even more dramatic. It yielded no less than the first giant building block in the foundation of modern physics.

God's power and light emanated from the center of the cosmos through the Holy Spirit. God's planetary subjects traveled in perfect circles as required by their perfection. The separation of the planets and periods of their orbits, could be determined by the geometry of the five perfect solids regulating the intervals between the six planets. All that remained to unleash this great revelation on to the world was the mathematical proof of its validity, a relatively simple exercise because it described a perfect geometrical view of God's secrets.

Kepler devoted the rest of his life to trying to prove this implausible system. But his rigorous approach to the mathematics of the problem led to one of the seminal discoveries in the development of modern science. Through years of tedious calculations using continuously more precise observations of the orbit of Mars, Kepler became convinced that the foundations of his theology—circular perfection of the planetary objects, unvarying orbital speeds, and ultimately his cosmic geometry of perfect solids—could no longer be valid. The language of the cosmos spoke, but the words were as unexpected as they were unwelcome.

His calculations of the actual geometry of planetary mechanics became known as Kepler's three laws. They provided the foundation for Newtonian physics and, in the present day, are still used as the basis for calculations of velocities and orbits of spacecraft in their journeys through the solar system.

Kepler's cosmology was the first fusion of theology and modern science. The energy created by the interaction of the two disciplines in the fertile mind of one individual formed the basis for great advances in both fields. For theology, God's creation was seen to be more complicated and subtle than indicated by the artificial perfection of earlier models. Yet theology survived intact. It was not a challenge to the mind of the Creator that this complexity existed, but a challenge instead to the inflexible human conceptualizations of God. The benefit of the synergy of these two fields to science was even more dramatic. It yielded no less than the first giant building block in the foundation of modern physics.

The Priest and the Paleontologist: Evolution and the Risen Christ

The introduction of Darwin's work, *On the Descent of Man*, in 1879, was a serious challenge, in some minds, to the foundations of Western theology. In fact, Darwin delayed publication of any manuscript relating to evolution and natural selection for twenty-three years after his return from the voyage of discovery aboard the *H.M.S. Beagle*, because he felt that all objections must be met before it could see the light of public scrutiny. In this fact alone, theology made a significant contribution to the cohesiveness of the new proposal.

By the early twentieth century, Darwinian evolution had established a firm foothold in the scientific community. Transformation through increasing complexity was given greater status as a fundamental property of the universe in the 1920s by the discovery that galaxies were moving apart. This discovery supported the idea that the universe itself was not static but was, in fact, evolving.

It was into this environment that a young Jesuit priest graduated with a doctorate in paleontology from the Sorbonne in Paris. Pierre Teilhard de Chardin was a devout practitioner of Catholicism and a mystic. In addition, his life as a scientist was engaged in the study of fossils and the evolution of life forms into new species. Like Kepler, he had one foot rooted in a need to understand the workings of God and the other in the rigorous search for empirical truth defined by the scientific method.

An Evolution-based Theology

Teilhard identified two trends as contrary and detrimental to traditional Christianity. First, doctrine was stagnating and leading the faithful away from the Mother Church.[4] He was convinced that his contributions to theology would serve as the source of new enthusiasm and vitality necessary to lead enlightened membership back to the faith community. The second trend was that the scientifically-driven changes in an understanding of the natural world could be viewed as a significant indication of God's work of creation. This new understanding was not to be ignored, because it showed definitively how God works and, more important, it showed God's plans for the created world. Teilhard explained the guiding force that brings these views into a working thesis of the universe and humankind's place in it as none other than the nemesis of orthodoxy: evolution. To Teilhard, evolution is the new lens through which humankind understands its place and the place of Christ in the cosmos. Evolution is "a prime property of experiential reality."[5]

Teilhard was careful to add that evolution does not exist as an independent force in the universe. This transformation is infused with the spirit of Christ as the true power of the process:

> [I]f a Christ is to be completely acceptable as an object of worship, he must be presented as the saviour of the idea and reality of evolution.[6]

The adaptations proposed by Teilhard were sufficiently radical to result in his being replaced as a professor of science at the *Institut Catholique*. This incident, ironically reminiscent of Kepler's experience, led to the start of his geological work in the Far East.[7] As further punishment, the Vatican prohibited the publication of his theological writings until after his death.

For Teilhard, evolution is the key to understanding the God of creation. Gradual transformation requires a continuous sequence of events built on the foundation laid by previous events. "To create a soul, God must first create a world." [8] Teilhard identifies the life of the universe as involving three phases. The first phase, well documented, is the development of the geosphere: all matter in the universe from subatomic particle to super-galaxy. The next level, the development of the biosphere, includes the evolution of life. *Homo sapiens* and its ability to observe, reason, and interact is the first step in the development of the highest level, the noosphere. Though consciousness exists as a separate spiritual layer in the universe,[9] humankind fills the unique role as the focal point of this consciousness. God's plan will be fully realized when a spiritual and intellectual unity exists among all sentient beings into a unified spiritual whole. When this result is achieved after billions of years of further evolution, the cosmos will have reached the Omega Point, a place of "supreme confluence and unity," [10] and the end point of the process.

This spirit of Christ, which has existed since the beginning of time, is the life force of Teilhard's theology. It is not driving the evolutionary force from behind, in deterministic fashion, but leading ahead and allowing transformation to converge towards the Omega Point. Teilhard describes Christ in this pathfinding role as the "God of the Ahead," [11] distinct from the "God of the Above." [12]

> If we assume Christ to be established ...at this remarkable cosmic point of all convergence, he then immediately becomes co-extensive with the vastness of space...as though at a universal crossroad....[13]

Christ's existence as role model for personal behavior becomes less important than that of unifier and synthesizer of the total spirit. "Christ the Redeemer has become Christ the Evolver." [14]

The need to reconcile Christ the Evolver with the traditional Christ the Redeemer has implications for the practice of Christianity. Teilhard describes as no less than a "religious crisis... that there exists an...antagonism between the God of supernatural revelation on one side, and the great mysterious figure of the universe on the other." [15] Humankind is no accident of the cosmos. It could have come in other forms, but the direction of evolution has given it the active responsibility, as the first sentient organism, to cross the bridge from biosphere to noosphere. Humanity has a position of privilege in that it can look to the past and envision the future. But every symbol of Christianity, in Teilhard's world, is a call to active participation in promoting the new world order.

The New Synthesis

Kepler formulated his theories on the workings of creation in a worldview dominated by a fixed traditional theology. Three hundred years later, the pendulum swung to the opposite extreme. Teilhard attempted to revitalize traditional theology by injecting it into a worldview dominated by a radical new understanding of creation produced by science. He and Kepler strove for the same result: a comprehensive cosmic view that incorporated the painstaking observations of the workings of nature and a persistent devotion to a personal and intercessionary God.

Both men fell short of their objective. Kepler's theology did not withstand the scrutiny of his own dogged search for material truth. Though Teilhard benefited from a more comprehensive understanding of the processes of nature, he failed to account for the future material evolution of the universe. Future development of the Whole would continue to take place in the environment of nature. Teilhard made no effort to account for this material future.

Neither man's efforts were in vain. Each pursued the study of nature as divine revelation and gave further meaning to human rationality. A study of science had been the foundation of this understanding. But the theology expressed, while not inconsistent with the science, offered a plan of action for human involvement.

Teilhard's synthesis of science and religion, and Kepler's before him, demonstrate that a deeper understanding of creation can lead to fresh insight into the meaning of human existence and its relationship with God. The refinements provided by both, and the discoveries that spawned them, have led to a far more profound and sophisticated view of the Creator than existed five hundred years ago. What lessons can be carried forward to reconstruct this synthesis and accommodate future discoveries?

A more fruitful understanding of the nature of God can be determined by a study of creation, though the answers may be unexpected, even unwelcome if they do not fit an overly rigid theological construction. There is greater insight waiting to be sorted out. Humankind is only beginning to struggle with concepts described by *Astronomy Magazine* columnist Bob Berman as "Bubbleland," concepts that are "beyond the present reach of science."[16] He describes self-contradictory concepts such as "the world before the Big Bang," zero-mass particles, and quantum weirdness, as more suggestive of human ignorance than of reality. These concepts are not clearly defined and offer much opportunity for further inquiry. The constructs that result may yet alter the view so far conceived. It will be incumbent on the thinking species to assess these ideas, as Kepler did, and find truth in the possible further reconstructions that result.

Teilhard and Kepler strove for the same result: a comprehensive cosmic view that incorporated the painstaking observations of the workings of nature and a persistent devotion to a personal and intercessionary God. Both men fell short of their objective. Neither man's efforts were in vain.

The Omega Point theory of physicist Frank Tippler is an example. He attempts to use theological concepts similar to those of Teilhard to predict the future of the universe and stipulate a sequence of events leading to Omega in the final singularity of a universe collapsed back on itself.[17] In Teilhardian fashion, all matter and intelligence will have merged into a "c-boundary," which "signals the end of spacetime, but lies just outside it."[18] Tippler's theory is consistent with one probable outcome of cosmology and with the current state of knowledge in information theory and cybernetics. While it advances a theology that is pluralistic, it offers less than satisfying guidance for the meaning and value of human life. But it is added to the sphere of discussion as grounds for productive debate.

Possibilities for relevant theologies abound in light of the information provided by a scientific study of the natural world. Process theologians use the evolving universe to develop metaphors of God as wisdom and persuasion. Liberation and feminist theologians include treatment of the environment with the human condition to propose an activist theology based on community and cooperative interaction.

As scientists speculate on the nature of reality, great opportunities—and responsibility—exist for theologians to contribute to a unified understanding of the cosmos. A theology that will play a relevant role as guide through the nature of reality will be consistent with these new explorations and will offer a sound explanation of the awesome privilege of being human. In addition, it will offer a means of evaluating the new technologies that will inevitably result. A fruitful exploration by scientists and theologians in the spirit of

Kepler and Teilhard, each profession acknowledging the contribution of the other, will use hard-gained knowledge in both fields to provide new meaning for human existence in the cosmos.

Works Cited:

Berman, Bob. 2000. "The Bubble Universe." *Astronomy Magazine* (June, 2000):94-95.

Koestler, Arthur. *The Sleepwalkers: The History of Man's Changing Vision of the Universe*. New York: Grosset and Dunlap, 1963.

Rae, Murray, Hilary Regan, and John Stenhouse, eds. *Science and Theology: Questions at the Interface*. Edinburgh. T. &T. Clark, 1994.

Teilhard de Chardin, Pierre. *Hymn of the Universe*. London: William Collins and Sons, 1965.

_____. "Note On the Physical Union Between The Humanity of Christ and the Faithful in the Course of Their Sanctification" (1920). In *Christianity and Evolution*, by Pierre Teilhard de Chardin, tr. by Rene Hague, 15-20. London: William Collins and Sons, 1971.

_____. "On The Notion of Creative Transformation" (1920). In *Christianity and Evolution*, by Pierre Teilhard de Chardin, tr. by Rene Hague, 21-24. London: William Collins and Sons, 1971.

_____. "Note On The Modes of Divine Action in the Universe" (1920). In *Christianity and Evolution*, by Pierre Teilhard de Chardin, tr. by Rene Hague, 25-35. London: William Collins and Sons, 1971.

_____. "Fall, Redemption, and Geocentrism" (1920). In *Christianity and Evolution*, by Pierre Teilhard de Chardin, tr. by Rene Hague, 36-44. London: William Collins and Sons, 1971.

_____. "Note On Some Possible Historical Representations of Original Sin" (1922). In *Christianity and Evolution*, by Pierre Teilhard de Chardin, tr. by Rene Hague, 45-55. London: William Collins and Sons, 1971.

_____. "Pantheism and Christianity" (1923). In *Christianity and Evolution*, by Pierre Teilhard de Chardin, tr. by Rene Hague, 56-75. London: William Collins and Sons, 1971.

_____. "Christology and Evolution" (1933). In *Christianity and Evolution*, by Pierre Teilhard de Chardin, tr. by Rene Hague, 76-95. London: William Collins and Sons, 1971.

_____. "Christ The Evolver, Or A Logical Development of the Idea of Redemption" (1942). In *Christianity and Evolution*, by Pierre Teilhard de Chardin, tr. by Rene Hague, 138-50. London: William Collins and Sons, 1971.

_____. "Christianity and Evolution: Suggestions For A New Theology" (1945). In *Christianity and Evolution*, by Pierre Teilhard de Chardin, tr. by Rene Hague, 173-80. London: William Collins and Sons, 1971.

_____. "The Christian Phenomenon" (1950). In *Christianity and Evolution*, by Pierre Teilhard de Chardin, tr. by Rene Hague, 199-208. London: William Collins and Sons, 1971.

Tipler, Frank J. "The Omega Point Theory: A Model of An Evolving God." In *Physics, Philosophy, and Theology: A Common Quest For Understanding*, ed. by Robert John Russell, William Stoeger, S.J., and George Coyne, S.J., 315-22. The Vatican City State: Vatican Observatory, 1986.

Endnotes:

1. Koestler, p. 239.
2. Ibid., p. 261.
3. Ibid.
4. Teilhard de Chardin, "Christianity and Evolution," p. 75.
5. Teilhard de Chardin, "Christology and Evolution, p. 175.
6. Ibid., p. 78.
7. Teilhard de Chardin, "Note On Some Possible Historical Representations," p. 55.
8. Teilhard de Chardin, "On The Notion of Creative Transformation," p. 32.
9. Teilhard de Chardin, "Fall, Redemption, and Geocentrism," p. 43.
10. Teilhard de Chardin, "Christ The Evolver," p. 143.
11. Teilhard de Chardin, "The Christian Phenomenon," p. 206.
12. Ibid.
13. Teilhard de Chardin, "Christology and Evolution," pp. 87-88.
14. Teilhard de Chardin, "Christianity and Evolution, p. 181.
15. Teilhard de Chardin, "Pantheism and Christianity," p. 65.
16. Berman, p. 106.
17. Tipler, p. 322.
18. Ibid.

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Islamic Contributions to Science: Historical and Contemporary Issues

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The normative practice in the history of science in the West is to start with the Greeks and then jump to the European Renaissance, both studied as a background for the emergence of modern science in the seventeenth century. More considerate works devote a few pages to the Islamic scientific tradition, as a harbinger of the Greek legacy. This practice, based on the nineteenth-century Orientalism, has seriously harmed the emergence of an accurate history of science in general and the nature of contributions made by the Islamic scientific tradition to science in particular. These accounts continue to produce a caricature of a tradition that lasted longer than the Greek and the modern scientific traditions. When placed in its own historical matrix, the nature of Islamic contributions to science is a totally different story.

Introduction

I suggest that the reader leave aside any preconceived ideas of Islam and Islamic scientific tradition for a few minutes and start afresh. This practice has the advantage of opening certain new vistas without any loss: if the new doors do not open, one can always go back to the older constructions. Let me also explain what I mean by the phrase "Islamic contributions," for it does not lend itself to a simple definition. After all, Islam is a religion and a way of life that has been around in different modalities since the beginning of human existence. This fact is often ignored and Islam is merely taken as that particular manifestation of the ancient religion that began on the 20th of August 610 CE with the first revelation to Prophet Muhammad while he was in retreat in the cave of Hirâ', about five miles south of Makkah.[1] This reductive interpretation of the term "Islam" is not in accordance with what followers of Islam believe. The message of Islam brought by Prophet Muhammad is merely *one particularized modality* of the ancient religion.

But whether we use the term Islam in its particularized modality or in its fuller sense, its central tenet has remained unchanged. It is a transforming concept known as *Tawhîd*, Unicity of God. Placed at the heart of the civilization that emerged from Islam in its ancient general sense as well as in all its particularized manifestations, *Tawhîd* refers to the existence of One, Unique God who can only be described in the negatives: God is not like anything else, unable to be fully contained in any human conceptualization, and without equal.

Taken in its fuller sense, the term "Islam" also refers to the act of submission to the Sovereignty and Majesty of the Creator not only by human beings but also by the earth, the moon, the stars, the planets and all created beings. Thus the Qur'ân speaks of the submission of the earth and the heavens in the same sense in which it speaks of the submission of Abraham to the commands of God. Abraham, let me add, is mentioned in the Qur'ân as some one who was neither a Jew nor a Christian, but a *Hanîf* and a Muslim.[2]

This universal aspect of Islam played a fundamental role in the development of science in the civilization that emerged from its particularized manifestation that began with the first revelation of the Qur'ânic verse, *Read!*, on an August day in 610 CE. The Qur'ân continued to be revealed for the next twenty-three years, a time during which Prophet Muhammad led a unique movement in the heart of Arabian desert. Based on the revealed message, this movement transformed Arabia from a semi-nomadic society situated at the outskirt of major currents of advanced civilizations to a dynamic state ready to expand its geographical boundaries at an unprecedented rate.

The expansion of the geographical boundaries of the Muslim world between 632 and 649 has often astonished Western historians and military experts:

633: Conquest of southern Mesopotamia

635: Conquest of Damascus, Persians defeated at Qâdisiya

636: Byzantines defeated on river Yarmuk

637: another defeat of Persians at Jalula

639: Conquest of Egypt

640: whole of Persia conquered

647: Tripolitania conquered

649: Muslim navy against Byzantines, Cyprus taken.

Let me also mention in passing that these military campaigns were undertaken by a state which was a mere ten years old. During the preceding ten years, the Muslim State had expanded from the small city of Madinah to include the whole of Arabia and the southern parts of Palestine and Iraq—covering approximately an area of one million square miles.

It is not my intention to follow all the subsequent periods of rapid expansions such as the one between 710 and 740 when Spain, Sind in the Indian subcontinent and a large part of Transoxania became part of the Muslim world within a span of thirty years. It is also not my intention to study the forces at work behind this expansion. More than the legendary expansion of the boundaries of the state, we are interested in the emergence of a new civilization that was to absorb, and make its own, an enormous amount of cultural and intellectual heritage accumulated over centuries by such diverse civilizations as the Hindu, the Syriac, the Greek, and the Chinese.

This appropriation and transformation of the cultural and scientific heritage of other civilizations by the emerging Islamic civilization was made possible, at least in part, by the fact that Muslims recognized previous manifestations of Islam and granted Jews and Christian the status of "People of the Book." This implied that they could live within the new state as Christians and Jews and decide their affairs according to their own laws. But it also meant that an ambience was created that fostered a close relationship between these religious communities and allowed free access to their cultural and intellectual achievements.

This was a social revolution of the first order that had profound contributions to the emergence of a sustained translation movement that would produce Arabic versions of a huge amount of Greek, Syriac and Persian texts with the help of Greek-, Syriac- and Persian-speaking Christians and Jews. But before considering the details of this translation movement, I wish to look at some of the inner dynamics of the Islamic civilization that created the need for these translations of scientific texts into Arabic.

By the time science emerged as an organized activity in the Muslim world, the Islamic civilization had already experienced two profound revolutions. The first was an intellectual revolution of the first order and the second, the aforementioned social revolution that united a large geographical area and diverse communities, a fact that had far-reaching consequences for the emerging scientific tradition.

The intellectual revolution was brought about by the intense meditation on the message of the Qur'ân. In the course of one generation, the Qur'ân had transformed the entire range of human experiences for the Arabs—from the rules of their language to the most mundane matters of daily life. In addition to containing a moral code, the principles of Islamic Law, and the majestic descriptions of human condition, the Qur'ân also contained a large number of verses that drew attention to the natural world. These so-called "scientific verses" of the Qur'ân not only speak of general phenomena like the water cycle, the orderly alternation of the day and the night, and the revolution of the sun and the moon in their orbits, they also mention specifics: the creation of all living things in pairs, the six stages in the birth of a human child, the making of honey by the honeybees, the construction of the spider-web. It should be noted that, in addition to their apparent meanings, these verses also have an allegorical meaning.

This fervent invitation to reflect on the signs, *ayât*, of the Creator throughout the manifest universe,[3] as well as within the human body itself, was to act as a driving force for the emergence of an intellectual movement that led to the birth of Islamic scientific tradition within a century. During the formative period of this nascent Islamic scientific tradition, a unique set of circumstances arose that had profound impact on its direction, content and maturing. Of course, reference here is to the famous translation movement that was to bring three major traditions to the doorsteps of emerging Islamic scientific tradition, which would first absorb them and then surpass them. The story of this fascinating process of assimilation of a large body of knowledge from the Greek, Persian, and Hindu traditions has been variously told. But I once again ask that previous notions regarding this process be set aside, for we are now about to embark upon new waters.

Western historians of science often present Islamic scientific tradition as a kind of railway junction where the train loaded with the Greek scientific heritage arrives, the driver of the train gets off, speaks Greek which is translated into Arabic by a team of translators under the able guidance of a Nestorian Christian by the name of Hunain ibn Ishâq (192-260/808-873). Having spoken his lines, the Greek driver departs on foot into oblivion, leaving behind an enormously rich heritage in its Arabic version.

Five centuries later, another team of translators discovers this Greek heritage in its Arabic garb, translates it into Latin in the newly established centers of learning in Spain and southern Europe, and thus the so-called antiquity of Europe comes back to its native land where it gives birth to modern science. More generous historians grant that during its habitat in the Arab homelands, Greek science was refined: and some even go to the extent of ascribing a few scientific advances to the Arabs. But a majority of texts still depict this whole operation as a conduit in which Islamic scientific tradition is no more than the halting place for Greek science.

Crombie is a forerunner of a peculiar breed of historians of science who advance the thesis that all that Muslim scientists did during the golden age of their science and civilization was to "add a few observations and comments of their own" to the received Greek science. This breed should be taken as a special branch of Orientalists; and though Orientalism has withered out from the mainstream discourse on Islam, this breed continues to thrive.

The roots of this story can be traced back to the tradition that is generally known as Orientalism, a word that has attained enormously rich connotations since Edward Said's 1978 book by that same title.[4] But these accounts are by no means a thing of the past; production continues of such caricatures of this unique confluence of three traditions that came to the Islamic world at a very specific and defining time in its history to influence the Islamic scientific tradition. They continue to haul rich and diverse human endeavors from one civilization to another as if it were dead wood. A case in point is a work by sociologist Toby Huff, *The Rise of Early Modern Science: Islam, China and the West.*[5] Another example is A. C. Crombie's influential work, *The History of Science: From Augustine to Galileo*,[6] in which Crombie makes several contradictory statements, often within a single page, about the worth and contributions of "Arab science" to Western Christendom. Examples abound:

> Of the actual knowledge from the stores of Greek learning which was transmitted to Western Christendom by the Arabs, together with some additional observations and comments of their own, some of the most important was the new Ptolemaic astronomy.[6]

One can find such examples on almost every page of the chapters dealing with "Arab science." Crombie is a forerunner of a peculiar breed of historians of science who advance the thesis that all that Muslim scientists did during the golden age of their science and civilization was to attach "some additional observations and comments of their own" to the received Greek science. This breed should be taken as a special branch of Orientalists; and though Orientalism has withered out from the mainstream discourse on Islam, this breed continues to thrive.

But let the haulers of dead wood ply their cargo. I believe that by stepping into the very heart of this process and seeing it as it happened, a richer and far more rewarding story can be constructed of the emergence of the Islamic scientific tradition as well as that of the translation movement that brought the Greek, Persian, and Indian works to Islamic science. All that one needs to do is to enter the enchanting world of the ᶜAbbasids just before the time of Abû Jaᶜfar ᶜAbdullâh al-Mansûr (c. 92-158/710-775), the second ᶜAbbâsid caliph and the founder of Baghdad—that wonderful city that seems to have been destined to witness some of the most momentous events of history down to our own times. Recall that the ᶜAbbâsids—that is, Banu'l-ᶜAbbâs, the family of al-ᶜAbbâs b. ᶜAbd al-Muttalib b. Hâshim, the uncle of the Prophet—had come to power after a ninety-year-long struggle against the Umayyads, whom they considered usurpers. Umayyads (Banû Umayya) had ruled the Muslim world from their capital Damascus, from 41/661 to 132/750.

Let us also recall that the ᶜAbbâsids had established strong relations with Persians, who provided the bulk of the army that won against the Umayyads. In fact, the army of the first ᶜAbbâsid caliph, Abû'l ᶜAbbâs al-Saffâh, had marched eastward from Khurâsan in Iran, which had become a strong supporter of the ᶜAbbâsid cause. The army that would eventually support al-Saffah made its triumphant march from the newly won Khurasan to Marw and then to Rayy, Kirman, and Nihâwand. In 132/749, the ᶜAbbâsid army crossed the Euphrates some 30 or 40 miles north of Kûfa and engaged and defeated a large Umayyad army led by Ibn Hubayra. Qahtaba, the leader of the ᶜAbbâsid army, died in the battle; but his son, al-Hasan b. Qahtaba, took command and led the army to Kûfa, which fell after some resistence. It was in Kûfa that the troops chose Abû'l ᶜAbbâs, the brother of Ibrâhim al-Imâm, as the first ᶜAbbâsid caliph with the title of al-Saffâh. Abû'l ᶜAbbâs transferred the capital of his caliphate first to the small town of Hâshimiyya, which he built on the east bank of the Euphrates near Kûfa, and then to al-Anbâr. Al-Saffah spent the rest of his life in consolidating the power of the ᶜAbbâsid rule, which would last for five centuries (132-656/750-1258), the period that covers the great achievements of the Islamic scientific tradition.

Islamic scientific tradition was built upon the foundation of religious sciences. These sciences had developed over the course of a century and provided the epistemological framework for the study of Nature. By the time of Khâlid b. Yazîd b. Muᶜâwiya (d. 84/704 or 89/708), known as al-Hakîm Âlé Marwân, the Philosopher of the Umayyads, who lived in Egypt and who collected a team of scholars to translate Greek alchemical works into Arabic,[7] the precise terminology that existed in the Qur'ân had been extensively studied and sciences of the Qur'ân, *al-ᶜulûm al-Qur'ân*, were well established. By then, Arabic, which would soon become the lingua franca of the Muslim world, had been systematize through the work of Abû'l Aswad al-Du'alî (fl. at Basra; d. c. 688/9); and the vast body of *Hadîth*, the sayings of the Prophet, was undergoing a rigorous scrutiny at the hands of early scholars of Hadîth, the *Muhadithûn*.

Let me restate that the translation movement was an organic process that arose as a response to certain internal dynamics of Islamic civilization; it was not an artificial process of germination dreamt up to jump-start a scientific movement.

The methodology developed for the study of Hadîth literature would help in the development of methodology of scientific investigation in certain indirect but decisive ways. The rigorous scrutiny of data, verification of sources, biographical research needed to ascertain the value and certainty of reports—all had an impact on the scientific methodology that evolved for the study of Nature. The systematic compilations of Hadîth literature at the hands of early Muhadithûn, such as Abû Abdullah Mâlik b. Anas al-Ashâbi (fl. at Madinah, b. 97/715, d. 178/795 or 179/796), who compiled the first such book, *Kitâb al-Mu'ata* (*The Book of the Beaten Path*), containing 1,700 traditions, also influenced the methodologies of science. This was also the time when the four orthodox Sunnî schools of law were in their formative stages. The intense legal activity that went into the making of these normative schools was yet another influence on the Islamic scientific tradition.[8]

In addition, one must recognize the importance of social factors that went into the making of the Islamic scientific tradition. The eighth century produced a vast and enormously rich and diverse cultural synthesis in the newly conquered lands that were brought under the caliphate. It was a world in which frontiers of scholarship were being redrawn. It was the time of the birth of a new culture, of an empire in the making, and of a tradition that was rapidly expanding. There were scholars and poets, writers and thinkers who were enriching Arabic with their works and who were forming that vast fraternity of Muslim scholars that would act as an alternate power as well as a check to absolutism in the new palaces that were being erected for the rulers. While all this was happening, a group of biographers were compiling the first biographies of the Prophet. Among them was the celebrated Abû ᶜAbdullah Muhammad b. Ishâq (fl. at Madinah until 114/733-34), the author of the first comprehensive biography of the Prophet, *Kitab Sîrat Rasul Allah*, completed at Baghdad.

Islamic scientific tradition came into existence in this rich intellectual milieu. It drew its metaphysics from the Qur'ân, its social make-up from the mingling of the Persian, Arab and other races; its methodology was influenced by the exactitude and vigor that had gone into the compilation of Hadîth literature, and its intellectual content was to come from diverse sources through a translation movement that has no parallel in human history.

But before looking more closely into this translation movement, let me note that, contrary to the claims of certain historians of science, it was not the translation movement that gave birth to the Islamic scientific tradition; the translation movement came into existence because there was an internal need and receptivity in the nascent Islamic scientific tradition that necessitated translations. It is absurd to assume that a vast scientific tradition can be produced merely by translating certain works of science and philosophy from another civilization. But such absurdities abound and remain unchecked when it comes to the history of Islamic scientific tradition. Note that, in spite of spending millions of dollars on the most advanced instruments and research facilities, and in spite of acquiring the services of highly qualified scientists, none of the contemporary oil-rich Muslim countries has been able to succeed in producing a local scientific tradition. Even if one does not consider historical evidence, this apparent fact should be enough to discredit the claims that Islamic scientific tradition was born because certain works were translated into Arabic.

My intent is not to minimize the importance or influence of the translation movement that came into existence in a social milieu that was cosmopolitan in the true sense of the word. It is hard to determine the precise beginnings of the translation movement; but what is known for sure is that when, upon the death of his brother, Abû Ja^cfar Abdullah became the second ᶜAbbâsid caliph with the title al-Mansûr (the Victorious), the translation movement was already under way.

Let me restate that the translation movement was an organic process that arose as a response to certain internal dynamics of the Islamic civilization; it was not an artificial process of germination dreamt up to jump-start a scientific movement. I have noted that the army that won the caliphate for al-Saffâh had come from Iran and al-Saffâh chose a city in Iraq, rather than Damascus, as his capital. It was the Hellenized Syro-Christian communities in Iraq who were the first sources for the translation movement, not the older Hellenic centers like Alexandria and Antioch.

Let me reconstruct the story from the year 136-37/754, when al-Mansûr became the second ᶜAbbâsid caliph, a time when the twelve-year-old Charlemagne was still fourteen years away from becoming the King of the Franks. One of the most important events at the beginning of the translation movement is a well-documented event of 147-48/765. In that year, Caliph al-Mansûr summoned the Syriac Christian Jûrjîs b. Bakhtîshûᶜ to his court. Jûrjîs was the head of the hospital at Jundishapur, and the Bakhtîshûᶜ family was long associated with the tradition of learning. His arrival in Baghdad established a Baghdad-Jundishpur axis that was to remain active for several centuries. Jûrjîs was made court physician, a position in which his family members succeeded him.

The Baghdad translation movement can be divided into three phases. It began with Ibn al-Muqaffaᶜ—a Zoroastrian whose interest and mastery of Greek philosophy is legendary—and his son and included Ibn Nâᶜmah and Eustathius, both of whom are known to have translated for al-Kindî, Thâbit b. Qurrah, and Ibn al-Batrîq. The second phase of the translation movement starts with the coming to caliphate of al-Ma'mûn (197-217/813-833), and the single most important figure of this period is the legendary Hunayn ibn Ishâq (192/808-260/873), the Nestorian Christian who is credited with a large number of translations from Greek and Syriac into Arabic, on subjects ranging from medicine, philosophy, astronomy, mathematics to magic and oneiromancy.[9] Out of the 129 titles enumerated by him in his famous *Risâlah* (see below), he himself translated about 100 into Syriac or Arabic or both. The list is not exhaustive.[10] The third phase of the translation movement marks the refinement of older translations at the hands of the Baghdadian philosophers like Abû Bishr Mattâ (d. 328/940), al-Fârâbî (d. 338/950), Yahyâ ibn ᶜAdi (d. 363/974), Abû Sulaymân al-Sijistâni (d. ca. 374/985), Ibn Zurᶜah (d. 1008), Ibn Suwâr (d. 1017), and Abû al-Faraj ibn al-Tayyib (d. 1043).

The scale and enormity of this translation activity can be glimpsed from certain simple facts: it lasted for three hundred years, and by the time it came to an end in the middle of the eleventh century, virtually all extant works of science and philosophy had been translated from Greek and Persian into Arabic. The sheer volume of the new material is staggering. But more than the volume, it is the extent of systematic effort that is impressive. Fortunately, a first-rate document by none other than Hunyan himself is extant, which helps to reconstruct an outline of what was involved. This is his *Risâlah*, which was intended to give a survey of his translation efforts on the Galenic corpus but which, in addition, provides general textual information about the methodology of translation as well as sources for texts. Edited and translated in 1925 by G. Bergstässer,[11] the *Risâlah* tells us that the manuscripts were hunted all over the caliphate, various Greek and Syriac versions were then collated (*qâbala*) through a process of oral reading by assistants. The variants were not discarded; rather they were carefully noted in the margins so that centuries later when Ibn Rushd wrote his *Great Commentary* on the *De anima*, he could cite variants from Ishâq's version in the body of the *lectio*.[12] A base text was thus established and translated into Arabic, creating a new technical language of expression in the process.

Reception of the "Foreign Sciences" in Islam

What was the impact of new translated texts on the Islamic civilization? What did the translated material do to the flowering of the scientific tradition? How did the new ideas blend into the framework of Islamic thought? What was it like to live at a time when these works of translation were coming into existence?

These are mighty questions; but for those who trade in dead wood, there is, once again, a simple answer: these "Foreign Sciences" were opposed by the dogmatic orthodoxy and finally the movement was chocked to death. Or, a slightly modified twist to the story asserts that the new material preserved the achievements of Greek science and philosophy in its Arabic version and remained dormant in the new environs until it was transmitted to Europe in the Middle Ages.

But if one is interested in living plants, rather than dead wood, one immediately grasps the magnitude of the questions. Recall that the translation movement was a sustained activity that lasted for at least 150 years (ca. 750-900) before blending into an equally long and important movement that was concerned with the refinement and recasting of the translated material. During this period of translation, no less than twenty-three ʿAbbâsid caliphs reigned over the ever-enlarging eastern empire, and separate caliphates were established in the Iberian peninsula and Egypt, both of which events had significant roles to play in transmission and learning in the Islamic civilization.

The translation of scholarship was an intellectual feat of the highest order and it was received in an environment that was pulsating with energy, ideas, intellectual vigor, new inventions, and unsurpassed economic activity that stretched from the heartland of the Arabian desert to the steppes of Central Asia. Caravans carried not only goods, but also scholars, ideas, books, legends, and stories. If one looks into the details of the books that were published during this time, one is struck with the awe-inspiring range of subjects and with the extent of passionate involvement of scholars in this activity.

Anyone interested in living organisms and understanding the dynamics of exchange between civilizations knows that no civilization passively receives ideas as if they are dead cargo. We know that the translation movement was nothing more or less than one ingredient out of a larger set that went into the making of what is called Islamic civilization. During the period of three centuries in which these translations were made and refined, some of the most celebrated scholars of Islam lived and died. During these same centuries, the Muslim world went through a series of transforming events that also contributed to that complex which is called Islamic civilization.

It must be noted also that the process of translation was an urban activity. Historians agree that urbanization was one of the most astonishing aspects of early Islamic history. Cities like Basra, Kûfa, and Baghdad on the Tigris-Euphrates system grew rapidly into major centers of Islamic scholarship, as did Cairo on the Nile, where a triumphant Fatimid dynasty had established their capital in 969 CE. In addition to the new cities, there were the ancient centers of spiritual and intellectual importance that came into the fold of Islamic civilization. These include cities like Damascus, Aleppo, Antioch, Jerusalem and

Alexandria. Then there were Iranian cities like Nishapur, which grew from 1,700-3,500 inhabitants before the Muslim conquest to 110,000-220,000 at its peak around the year 1000.[13] Isfahan may also be mentioned, which was to grow from about 20,000 inhabitants to 200,000 in the same time span, and which has remained a center of learning for centuries. One may conclude, then, that this urban activity must have taken place in centers not unlike modern research centers with library facilities and permanent staff.

Scholars know for sure that institutions existed, variously called *bayt al-hikmah, dâr al-hikmah*, or *dâr al-ᶜilm*, where translation work was carried out in a systematic manner. In addition to al-Ma'mûn's bayt al-hikmah, (literally, House of Wisdom) in Baghdad, records show the existence of a dâr al-ᶜilm (literally, House of Knowledge) in the same city under the Buwayhid vizier Sabûr b. Ardishîr (d.1025), and the existence of similar institutions founded by the Hamdanids in Mosul, Aleppo and Tripoli. Likewise, records show the existence of an institution by the name of dâr al-hikmah, founded in Cairo by the Fatimid caliph al-Hâkim.[14] All of this suggests that the new material was received in a dynamic situation and that it was under a continuous process of evolution and change, involving integration, rejection, and adaptation.

The Flowering

It should be noted that the Islamic tradition of learning did not classify various branches of knowledge in the same way as is done today. It had its own schemes of classification and, in fact, classification of knowledge was a major discipline by itself. This classification was so fundamental to the whole tradition that some of the best minds spent their energies on defining the limits and boundaries of various sciences (*ᶜulûm*). The Arabic word for science is *ᶜilm*, but it does not mean science in the contemporary sense. Rather, it means something much greater. From al-Kindî (3rd/9th) to Shah Waliallah of Delhi (12th/18th), all major Muslim thinkers contributed to the refinement of classification of sciences (*al-'ulum*). This almost obsessive attention to the problem of the classification of sciences is not an empty intellectual pursuit, as it may appear at first sight. The basic motive behind it was, and is, to preserve the hierarchy of each science and to determine the scope and position of each within the Islamic worldview. This was essential because, without such a classification, there would have been no established hierarchy of sciences and much confusion as to the ultimate ends that can be achieved by pursuing a particular branch of knowledge. Since each branch of knowledge was considered to be part of an integral whole, like branches on a tree, their ultimate purpose was also related to a central, unifying principle beyond which their pursuit was considered to be futile.

The first sciences to emerge in Islam were the religious sciences, because the foremost problem faced by faithful believers was to know how to know God. The path to this knowledge, outlined in the Qur'ân, had to be elucidated. This gave rise to the science of interpretation of the Qur'ân, *'ilm al-tafsir*. This was followed by the sciences related to the preservation of the sayings of the Prophet (*'ilm al-Hadîth*), the science of biographies (*'ilm al-rijâl*), the science of genealogy (*'ilm al-ansâb*), and the science of history (*'ilm al-târikh*). These religious sciences provided a framework of scientific inquiry that was later employed for the natural sciences. The key elements of this methodology were uncompromising adherence to truth and objectivity, a respect for corroborated empirical evidence, an eye for detail, and the development of mental skills for the classification of data.

Thus, before scientific enterprise began, Muslims already had a rich repository of technical terminology[15] that soon paved the way for the development of a conceptual framework from which various branches of science emerged in due course of time. This terminology is essentially based on and revolves around the Qur'ânic concepts of life, death, resurrection, prophethood, and human moral response to the whole scheme of a purposeful creation of the universe.[16]

It is interesting to note that the classification activity gained momentum as soon as Islamic civilization came into contact with the Greco-Hellenistic scientific and philosophical thought. Until then, there had been no external threat to the established hierarchy, and the tacit understanding of the position of each science was sufficient to keep the integrity of the hierarchy. Thus, Jabir ibn Hayyan (c.103/721-c.200/815), to whom an extraordinary number of writings has been ascribed,[17] was not excessively concerned with the problem of classification; but al-Kindî[18] (c.185-260/801-873)—the "Philosopher of the Arabs"—was, because by then the major movement of translation of Greco-Hellenistic scientific works into Arabic had already begun. Nevertheless, Jabir did write his famous *Books of Balance* to explain his theory of balance, which underscores the whole of his alchemy. Likewise, Hunain ibn Ishaq[19] and Thabit ibn Qurrah[20] (211 or 221-288/826 or 836-901), both pioneers of translation movement, did not have to pay attention to the problems of classification. Even Muhammad ibn Musa al-Khawarazmi (d. c.249/863), who died just eleven years before the death of al-Kindî, was not concerned with the classification problem, though his work represents a creative synthesis of the mathematical works of the generation preceding him.[21] Râzî[22] was also not concerned with the problem of classification, though his contemporary Abu Nasr al-Fârâbî (c. 258-339/870-950) was to devote much of his life to the development of a comprehensive scheme of classification of sciences.

From al-Kindî (3rd/9th) to Shah Waliallah of Delhi (12th/18th), all major Muslim thinkers contributed to the refinement of the classification of sciences (*al-'ulûm*). This almost obsessive attention to the problem of classification of sciences is not an empty intellectual pursuit, as it may appear at first sight. The basic motive behind it was, and is, to preserve the hierarchy of each science and to determine the scope and position of each within the Islamic worldview.

Within the first century of Islam, Muslim scientists developed the science of alchemy, which has a distinct metaphysical aspect and which explored the underlying balance in nature. Alchemy, as understood by traditional Muslim scientists, has to do not only with the physical domain of existence, but also with the spiritual domain. Blending the symbolism from the metaphysical domain with the physical domain, a rich tapestry of metaphors, symbols and images has been preserved for use in retracing the history of this most wonderful of all branches of Islamic science. Thus, in the spiritual sense, one comes across the subtle symbolism of the spirit's journey and the rites and stages of transformation of the soul, which is the subject matter of "Spiritual Alchemy." Linked to this, and at a lower level, is the alchemy of the craft guilds, especially dealing with metals and their transformation. Linked to each other through the symbolism of a common language, this science provides the most obvious example of metaphysical grounding of Islamic science. The alchemical tradition is definitely pre-Islamic in its origin, dating back to the prehistoric period of human existence. But, like so many other branches of knowledge, once incorporated into the Islamic worldview, it transformed and became distinctively Islamic in its metaphysical basis. The Western form of alchemy, developed in Alexandria about the time of the birth of Jesus Christ, came into existence through the hybridization of cosmological doctrines of Egyptian tradition with the Greek philosophical tradition. The earliest texts of Alexandrian alchemy refer back to the Prophet Enoch (in Hebrew) or Idris (in Arabic).[23]

Jabir ibn Hayyan, a mystic and perhaps the greatest alchemist produced by the Islamic scientific tradition, was acutely aware of this long tradition of alchemy. He wrote:

> Know that successive philosophers have enabled the science of [alchemy] to profit from a long development, and have given it an extraordinary power, thus attaining their end. Arius [precursor of Hermes] was the first of those who devoted himself to this art....[24]

In *The Book of Balance*, Jabir is basically concerned with finding the correct proportion of the qualities or natures—namely, hot, cold, moist, and dry—which can be found on the basis of the idea of Balance. Proportion, for sure, is nothing but a relationship, expressed in numbers that are understood in the Pythagorean sense as ontological aspects of Divine Unity.

In Jabir's system, each metal has two exterior and two interior qualities. Gold, for example, is inwardly cold and dry, outwardly hot and humid. Silver is just the reverse: hot and humid inwardly, cold and dry outwardly.[25] Each quality has four degrees and seven subdivisions (twenty-eight parts in total). Jabir says that everything in this world exists by the number 17, divided into the series 1:3:5:8. Each of the twenty-eight parts of the qualities is linked to the letters of the Arabic alphabet and the four-fold division is based upon the series 1:3:5:8. The opposing natures of the metals are in the ratio of either 1:3 or 5:8 or vice versa.[26]

Thus, in a purely Jabirian sense, the whole universe can be explained on the basis of his alchemy which, in turn, is based on a theory of cosmology evolved on the basis of *Tawhîd*, the Oneness of God. Jabir's alchemical writings have a dual aspect: there are texts that can be easily understood in terms of modern chemistry and there are texts that explain various levels of cosmic reality, explained in terms of masculine-feminine or sulfur-mercury principles.[27]

In traditional Islamic cosmology, formulated by Jabir and others, a lower state always derives its existence from a higher state and, in turn, transmits to the state lying below it in the Chain of Being. Elements of alchemy are a part of the great Chain of Being, which in turn derives its existence from the principle of *Tawhîd*.

This esoteric interpretation of Nature as the cosmic text (*ta'wîl*) is central to Jabir's worldview, as well as to the doctrines of all major Sufis in the Islamic tradition. ʿAziz al-Nasafi, the 8th/15th-century Sufi master, has compared Nature to the Qur'ân in an elaborate scheme in which each genus in Nature corresponds to a *Surah*, each species to a verse and each particular being to a letter.[28]

Withering: Why, When, and How

Why did the Islamic scientific tradition wither and then disappear? When and how did it happen?

These are, once again, mighty questions that have not been fully researched. But the haulers of dead wood have their answers for these, as well. They postulate that there was a man by the name of al-Ghazâlî (450-505/1058-1111) who wrote a book, *Tahâfut al-Falâsifah* (*The Incoherence of the Philosophers*), in which he attacked the philosophers and scientists; and, because he had an enormous influence, rational inquiry into Nature died in the Islamic civilization—this, even though Ibn Rushd (520-595/1126–98), our very dear Averroes the Commentator, as he is known in the Latin West, wrote a line-by-line refutation of al-Ghazâlî's work in his seminal *Tahâfut al-Tahâfut* (*The Incoherence of the Incoherence*), which came too late. They also add other factors to their list of causes of decline; these range from the disintegration of the caliphate to the Mongol attack, and from the internal strife of Muslim polity to the lack of institutional support.

As to the date of decline, they have been grudgingly moving it forward as more and more data come to light. Until quite recently, the date most often cited was the tenth century, but a more recent trend has been to cite a rather ambiguous "thirteenth or fourteenth century." This revision has been made thanks to works by E. S. Kennedy, George Saliba, Shlomo Pines, and others.[29]

But in addition to the obvious traders of dead wood, there are more subversive formulations. These find fault with the very structure of the scientific enterprise in the Islamic civilization and then use this claim as an anchor to pass disparaging judgment against Islam itself. "The problem [of growth of Islamic science into modern science] was not internal and scientific, but sociological and cultural." Huff tells us in *The Rise of Early Modern Science*:

> It hinged on the problem of institutional building. If in the long run scientific thought and intellectual creativity in general are to keep themselves alive and advance into new domains of conquest and creativity, multiply spheres of freedom—what we may call neutral zones—must exist within which large groups of people can pursue their genius free from the censure of political and religious authorities. In addition, certain metaphysical can philosophical assumptions must accompany this freedom. Insofar as science is concerned, individuals must be conceived to be endowed with reason, the world must be thought to be a rational and consistent whole, and various levels of universal representation, participation, and discourse must be available. It is precisely here that one finds the great weakness of Arabic-Islamic civilization as an incubator of modern science.[30]

This is one example of what may be called neo-Orientalism in historiography of science. Here, modern Western science and the way it evolved is taken as the only valid mode in which a science—any science—could grow, and then this norm is placed upon all other traditions to explain their "failure" to evolve into modern science.

There are two pitfalls to this approach: it assumes that modern science is the model *par excellence* that should have been followed by every scientific tradition in the world, and it further supposes that the only route available to any science for this achievement is precisely the one taken by modern Western science. On the basis of these two assumptions, all other scientific traditions are denigrated. Unfortunately, in the case of Islam, this denigration does not stop at the scientific tradition; often invalid conclusions are drawn that cover the whole civilization and its fundamental principles. One can cite many examples in addition to the aforementioned case, but that would take me away from my main task. Suffice it to say that this approach is fundamentally flawed, if not outright biased and dishonest. Each civilization works within its own dynamics. Had the process of learning through a one-to-one relationship with a sage—so esteemed in Islam, but of no value in Huff's and Crombie's assessment—been inadequate, there would have been no Ibn Sînâ and no Ibn al-Haytham. When Huff says that "both the Islamic and Judaic cultures contained a strong bias against allowing open access to knowledge by the masses,"[31] one is clearly up against a closed mind that has certain preconceived notions about Islam and Judaism on the basis of inadequate or biased—or both inadequate and biased—training. The example cited by Huff in this particular case is that major work by Maimonides (1135-1204), *The Guide of the Perplexed*, on which he labored for fifteen years and which is universally recognized as one of the best example of the integration of science, philosophy, and religion within the Jewish tradition.

Returning to the main question, regardless of the inadequate, biased and uninformed reasons provided by traders of dead wood, one does have a reality to explain: Islamic scientific tradition did die—and to such an extent that no such endeavor can be found today that can be called Islamic science. What happened to the once-flourishing enterprise? What were the causes of its failure to sustain itself? Where did it go?

Let me confess: I do not have an answer; in fact, no one does, except for the type of scholars mentioned above. There are many reasons for the lack of an answer—or perhaps we should say answers, for there cannot be simply one answer to such a complex question. The state of contemporary scholarship does not permit us to provide any definite answers to the question of decline. As a matter of fact, even the questions have not been formulated properly. What is meant by the decline of Islamic scientific tradition? When did it happen? Why did it happen? But the only question that is generally asked is: Why did Islamic scientific tradition fail to produce "the scientific revolution" of the kind that occurred in Europe in the seventeenth century?

The Question of Decline

As the Muslim world grapples with its present state, the question of decline of Islamic scientific tradition seems to gain more and more importance, because the present crisis is viewed as resulting largely from a lack of scientific and technological know-how, especially when seen with an awareness of Western political and economic power, which is ascribed to science and technology. But apart from this general view, historians of Islamic scientific tradition are also paying much attention to this question, and some even consider it to be a subject at the cutting edge of historical research.

One of the most important aspects of the question is the fact that one is not dealing with just the decline of the Islamic scientific tradition; it was actually the Islamic tradition of learning that declined and disappeared, and along with it went the sciences. This is something that was well recognized by the Muslims themselves, and serious efforts were being made for recovery when almost the whole of the Muslim world was colonized. During a century-long occupation, the colonizing forces systematically crippled, destroyed, and desecrated the tradition, perhaps forever. In any case, the colonial occupation went deep and produced the contemporary Muslim world where there exists neither the Islamic tradition of learning nor Islamic science.

In addition, while formulating the questions, one must also take into account that the decline of Islamic scientific tradition was not like a plague that spread over the large geographical region that was part of the Muslim world and killed every single scientist and scientific institution in a specific time span. Rather, each region and each branch of science requires individual attention for, as A. I. Sabra has pointed out, "decline in one branch of science may coincide with progress in another."[32]

A third aspect of the question of decline is the relationship between the Islamic worldview and different branches of science. Science had progressed in the Islamic civilization within a conceptual framework that informed, checked, and controlled its direction. There were two main views of science and its relation to this framework: the instrumentalist view and the puritan view.

The instrumentalist view considered the scientific enterprise as an instrument to help reach the major goal of human life, namely, preparation for the eternal life. Thus, only those sciences were considered praiseworthy that helped in the preparation for the next world, and their study was only desirable to the extent of their utility. This attitude is epitomized by al-Ghazâlî who formulated his thesis in a bold and assertive manner in the first book (*Kitab al-ᶜilm, the Book of Knowledge*) of his magnum opus, *The Revival of the Religeous Sciences*, and in his autobiography, as well, *al-Munqidh min al-Dalal* (Deliverence From Error).[33] Al-Ghazâlî was

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a grand synthesizer of Islamic intellectual and spiritual traditions. After recovering from his spiritual crisis, al-Ghazâlî saw everything in the luminous light of his transformed soul and yearned for ever-increasing nearness to the Creator. He viewed all human pursuits—including the pursuit of knowledge—as means to the ultimate goal that he set forth as none other than salvation in the hereafter. This grand vision of a man who had been at the forefront of intellectual tradition before his spiritual crisis has often been held responsible for the demise of science in the Muslim world, but nothing can be more erroneous than this hasty and simplistic conclusion. What al-Ghazâlî called for was not the elimination of natural sciences from the content of Islamic education, as he is sometimes accused of, but a re-establishment of the hierarchy of various branches of knowledge. His was an effort based on the specific conditions of his times, an era rife with intellectual anarchy and confusion. He wanted to restore and realign the Islamic intellectual life toward its legitimate direction. His was the voice of a mystic who had passed through the domain of intellectual knowledge and who was now rooted in the spiritual certitude where his thoughts and actions, desires and values, teachings and practices were all directed toward the ultimate goal of salvation in the hereafter.

But al-Ghazâlî's doctrine was certainly not the only doctrine in the Muslim world. In contrast to his religiously committed stand, there was the view of the philosophically committed scholars who understood the goal of theoretical investigation to be an understanding of the nature of things as they are in themselves, without any further commitment. Thus, for them, the ultimate purpose of inquiry—whether in mathematics, astronomy, physics, or metaphysics—was to gain knowledge for the sake of knowledge, which was considered to be good in itself. A further branch of philosophical sciences, *al-ᶜulûm al-hikmiyyah*, viewed the purpose of philosophical inquiry as the perfection of the human soul and its preparation for eternal happiness. These *hukama* (sages) were inclined toward metaphysics, and they viewed their ultimate goal to be no different than that of al-Ghazâlî's—only their path was different.

The instrumentalist view of science was neither new nor the only view. In all civilizations, science has always served certain purposes, while, at the same time, it is a means to understand Nature and its workings. Even modern science does that. Thus, there is nothing surprising in the fact that astronomy was used right from the beginning to determine the direction of prayer, the *qibla*, and for lunar visibility. And mathematics was an important tool in the computation of prayer times; in fact, the office of *muwâqqit*, the one charged with the determination of prayer times, was often occupied by an astronomer or mathematician. But this was not the only function of astronomy and mathematics; they were legitimate sciences in their own right, which were pursued within the larger framework of Islamic scientific tradition. Thus, the two views represented by the instrumentalists and the philosopher-scientists are not water-tight compartments; they arise on the basis of degree of emphasis.

Finally, I wish to examine the explanation of decline that places the blame on the lack of institutional settings for the pursuit of science. This is often presented as the grand failure of Islamic civilization. It rests on the assertion that the only formal institution of learning in Islamic civilization, the madrassa, did not have the rational and philosophical sciences in its curriculum. In summing up this argument, Sabra states:

> [T]he marginality thesis relies in part on the fact that the major Islamic institution of higher learning, the madrassa, formally ignored the rational or philosophical sciences. The consequence drawn from this fact is that Muslim institutional education, having excluded these sciences from its purview, could not serve as a means for their promotion or propagation. Science was accordingly forced to lead a separate, private and precarious existence which, so the argument would go, it could not maintain indefinitely. The argument is compelling and may even contain a large portion of truth.

> For my part, I am convinced that the character of the madrassas, and the circumstances and motivations that brought about their proliferation under the Saljûqs in the second half of the eleventh century, are important factors that must be considered in any attempt to understand the future career of Islamic science. What has yet to be made clear, however, is the precise nature of these factors and the precise way in which they affected the course of science.[34]

In an attempt to elucidate his point, Sabra further mentions that the madrassa was a *waqf* institution, a charitable foundation:

> [A]s such, it belonged to a type of institutions which any Muslim could endow in his capacity as a private individual.[35]

He also notes that Nizâm al-Mulk, the Saljûq vizier directly responsible for initiating the system of madrassas which quickly spread over Iraq/Khurâsân at a time when the subversive Ismâᶜîlî propaganda was threatening the doctrinal unity of the Ummah, community of believers, may have "legally acted as a private individual."

> [I]t may be debated whether the Nizâmiyya madrassas were originally conceived as rivals or emulators of *dûr al-ᶜilm*, the library-cum-teaching institutions which, like the original *dûr al-ᶜilm* in Fâtimid Cairo, had made room for the philosophical sciences.

Sabra notes further:

> [The madrassas] quickly replaced the *dûr al-ᶜilm*, thus bringing to an end one of the few institutional homes in which the foreign sciences had been cultivated without inhibition....[36]

It is a problematic assertion, to say the least. The madrassa, as an institution, was not the brain-child of Nizâm al-Mulk (408-485/1018-1092); it predates the venerable Nizâm by four centuries. In its earliest form, it was present during the life of the Prophet, and it is known that most mosques had madrassas attached to them. Larger mosque-madrassas often had libraries associated with them, and private individuals often made contributions to the upkeep of these libraries and of the madrassa-khân, that is, the madrassa which also provided lodging for the out-of-town students. No doubt Nizâm al-Mulk endowed scholarship for students and infused new life into this institution, but there is no historical evidence to suggest that he in fact founded the institution of the madrassa.[37]

In any case, there are examples to suggest an integration of various branches of learning within a complex. One such example is the still-standing madrassa complex in Samarqand, not far from the famous observatory.

Muslim institutions of higher learning were characteristically different from those that evolved in Europe and grew into modern universities. To claim that science in the Muslim world could have continued only if there had been universities of the European kind is absurd. Each civilization has its own institutions, and science did progress in the Muslim world for centuries without the universities of the European type.

We are, thus, left with unresolved questions. But all that can be done at this stage of our understanding is an attempt to formulate questions, rather than provide answers.

When and Where Did the Decline Occur?

Even the most biased historians of science now grant that Islamic science was still active up until the fifteenth century. They accept that the famous Marâgah observatory and research center established by Nasîr al-Dîn al-Tûsî was among the best research centers of the world, where outstanding scientists such as Qutb al-Dîn al-Shîrâzi (634-710/1236-1311), Muáyyid al-Din al-ᶜUrdî (d. 665/1266), Muhyi al-Dîn al-Maghribî (d. 680/1281), and even the Chinese astronomer, Fao-Mun-Ji, were active, and where the *Zij-i îilkhânî* (The Îl-Khânid Tables) were produced, first in Persian and later translated into Arabic. Marâgah was also a place where new instruments were constructed and where major contributions were made to planetary theory. It is also well recognized that al-Tûsî's remarkable contribution to the planetary theory, later named "the Tûsî couple," was being studied by astronomer Ibn al-Shâtir (d. 1375). In the fifteenth century, Ulugh Beg

(796-853/1394-1449) was busy in constructing a new observatory at Samarqand, where Ghiyâth al-Dîn Jamshîd al-Kâshâni (d. 832/1429), the famous mathematician and compiler of the *Zîj-i khâqânî* would prepare his *Zîj-e Ulugh Beg* with help from his colleagues, one of them being the accomplished astronomer Qâdî-Zâdeh Rûmî. Yet another short era of robust astronomical activity was witnessed in Istanbul in the work by Taqî al-Dîn in the $10^{th}/16^{th}$ century. Considering all of this, one must look for reasons for the so-called decline in a time period that lies somewhere in the sixteenth century.

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It is important to look for reasons that are far more comprehensive and deeper than what has been so far suggested in socio-historical accounts or by way of denigration. One must also look at the reform-revival movements that had sprung up all over the Muslim world and that were seeking to build a new social and political order. This process was cut short by colonization and subjugation of the Muslim world, which brought the whole civilization to a crumbling halt.

The Islamic Scientific Tradition and the Making of Modern Science

Europe received the Islamic scientific tradition during the Middle Ages, which were not really "the Dark Ages" as is usually believed; rather, the very idea of Dark Ages first arose in the late fourteenth and early fifteenth century out of arrogance. It was a derogatory term to be placed beside and contrasted with the idea of enlightenment. It became firmly entrenched in Western culture as the European Renaissance progressed.[38]

European scientific tradition of the Middle Ages was primarily situated in the chain of Christian monasteries spread throughout Europe. These monasteries had started as early as the fourth century. By the time St. Benedict (d. ca. 550) established his monastery at Monte Cassino, south of Rome, this way of life had matured so that he could formulate rules governing the lives of those who chose to live in these monasteries.[39] Bede, who entered the monastery of Wearmouth in Northumbria, in northeastern England near modern Newcastle, at the age of seven to spend the remainder of his life, also left his mark on a whole range of subjects taught in the eighth century. Included in his works is the *Ecclesiastical History of the English People* and *On the Nature of Things*, as well as two textbooks on timekeeping and the calendar.[40]

The focus of monastic tradition was ecclesiastical, but this does not mean that medicine, logic, and other Greek and Roman sciences were altogether absent from the communal life. It is known that Boethius (480–524) translated parts of Aristotle's *Logic* and composed handbooks on the liberal arts. Gregory the Great (ca. 550–604), who became pope in 590, left behind a respectable body of sermons, lectures, dialogues, and biblical commentaries. Toward the end of the eighth century, there was another burst of energy that revived the tradition of learning, this time under the patronage of Charlemagne the Great, who inherited a Frankish kingdom in 768 which contained parts of modern Germany and most of France, Belgium, and Holland. By the time of his death in 814, he had enlarged his kingdom to include more German territory, Switzerland, part of Austria, and more than half of Italy. His empire, known as the Carolingian Empire, was the first centralized empire to appear in Europe since the Roman Empire. Charlemagne instituted a state-wide educational enterprise under Alcuin (ca. 730–804), who had been headmaster of the cathedral school at York, in northern England, before he was brought to the court of Charlemagne especially to direct the new educational enterprise.[41]

It was this educational system under Alcuin leadership which was to initiate the transmission of Greek learning (through the Arabic route) into Western Europe. An imperial edict mandated the establishment of cathedral and monastery schools. This laid a foundation on which was built the grand edifice of learning in later centuries.[42] Alcuin attracted a group of scholars who were interested in serious theological reflection, and it was this system of schools that produced men like John Scotus Eriugena (fl. 850–75)—an Irishman attached to the court of Charlemagne's grandson, Charles the Bald. Scotus was the most influential and ablest scholar of the ninth-century Latin West, with an excellent command of Greek acquired in the monastic schools. He went on to translate a number of important Greek works into Latin and to write several original works in Latin.

A century later, another beneficiary of Carolingian educational system, Gerbert of Aurillac, was to become one of the first intellectual links between Islam and Latin Christendom. Gerbert rose from his humble beginnings to the high office of pope through a series of dramatic events that exhibit his sharp intelligence as well as his scholarship. His election as Pope Sylvester II in 999 provided him an institutional structure for the pursuit of his scholarly ambitions. But already in 967 when Gerbert crossed the Pyrenees into the northeastern corner of Spain to study mathematical sciences with Atto, the bishop of Vich, he had forged a link with Muslim Spain that was to serve as a decisive point of contact between Islamic scientific tradition and the Latin West.

Gerbert's letters are the source for ascertaining the extent of his interest in Islamic sciences at this early stage of intellectual interaction between Muslim Spain and Europe. *The Letters of Gerbert with His Papal Privileges as Sylvester II* provide ample testimony to Gerbert's wide ranging interests as well as influence.[43] In these letters, one finds Gerbert asking for specific manuscripts and books. In one letter, he asks for a book on numbers by the Arabic-speaking Christian, Joseph the Spaniard; in another, he asks for a book on astronomy which had been translated from Arabic by Luptins. He instructs friends on mathematical and geometrical problems and imparts instructions on the construction of astronomical models as well as on the use of the abacus for multiplication and division, using Arabic numerals.

Transmission

Gerbert did not live to see the enormous changes that were about to transform Western Europe during the eleventh and the twelfth centuries—transformations that were crucial to the emergence of modern science. After the Viking and Magyar invasions of the ninth and tenth centuries, which devastated much of Europe, there came a period of strong monarchies, political stability, and economic growth. The reasons for these developments are complex and beyond the scope of this essay. Suffice it to say that after enduring the invasions of foreign armies for centuries, Western Europe reversed the pattern and became an aggressor, first in Spain and then in the Holy Land, where it dispatched armies of crusaders. As a result of re-urbanization, a new educational system emerged. Stable, prosperous monarchies, continuous economic growth, and increased agricultural production between 1000 and 1200 contributed to a population explosion during which the population of Europe may have quadrupled.[44]

During the eleventh and the twelfth centuries, along with the population explosion, there arose a chain of new schools throughout western Europe with far broader aims than those of monastery schools. What is important for my purposes is the fact that these schools were centered on the interests of the "master" who directed them, just like the schools in the Islamic civilization that attracted students to a particular teacher whose name was synonymous with that of the school. And just like their counterpart in the Muslim world, these European schools were not fixed geographically: they went where their master-teacher went.[45]

These new schools multiplied. The number of students and teachers increased, and some of them became large enough to need organization and administration; this was the beginning of the evolution of the universities which would subsequently become home to intense scientific activity.

These universities arose in western Europe as spontaneously as the schools had. No date can be fixed for their founding, because they were not founded. At that early stage, universities were not educational institutions with buildings and charters; rather, the early universities were merely voluntary associations or guilds where teachers and students pursued their common interests. The word "university" (from the Latin *universitas*) merely meant a guild, corporation, or association where people pursued common (universal) ends; it had no educational connotations. Nonetheless, the customary date for the masters of Bologna to have achieved university status is 1150; for those of Paris, about 1200; and for those of Oxford, 1220.[46]

The presence of stable monarchies created opportunities for employment of learned scholars at courts, as well as the need for administrators for growing state institutions. This meant expansion of universities and their curricula. Education in these early universities followed the centuries-old tradition of guilds that had been established all over the world. A student entered university at about age fourteen and studied with a teacher for three to four years, attending lectures and discussing various books and authors. At the end of that period, the student would present himself to be examined for the young man's degree. Having passed this examination, the student now became a sort of journeyman, who could impart instructions to new students under the direction of a master, while he continued his own studies. After another period of three to five years, the student could present himself for a higher examination that would confer full rights on him and give him full membership in the faculty of arts.

These universities were bigger than schools; numbers varied between 200 and 800 students. Oxford probably had between 1,000 to 1,500 students in the fourteenth century; Bologna was of similar size, but Paris may have had up to 2,500 students.[47]

For this study, more important than number of students is the curriculum of these universities. What was taught changed over time, but an interesting feature of these early universities was their uniformity in curriculum. There were minor differences in emphasis, but almost all universities taught the same subjects from the same texts. This may have been the result of paucity of texts at this stage, but this common curriculum produced a phenomenal result: medieval Europe acquired a universal set of Greek and Arabic texts, as well as a common set of problems, a situation that facilitated a high degree of student and teacher mobility across country boundaries. Thus, teachers earned their *ius ubique docendi* (right of teaching anywhere) and moved between different universities, all of which used Latin as their language of instruction.

This, again, demonstrates an important parallel between medieval Europe and the Muslim world, where Arabic was the universal language of scholarship and where students and teachers easily moved across a vast geographical expanse.

Perhaps the most important characteristic of the medieval European university curriculum was the fact that, from its modest beginnings in the twelfth century, the Aristotelian tradition grew to hold center stage by the second half of the thirteenth century. This was due partly to the intense transmission activity that had brought the whole Aristotelian corpus from its Arab home to Europe.

The links between Muslims and Europeans had never been completely severed. Travelers, traders, and border cities with a multilingual populace kept the links alive. As early as 950, there was an official exchange of ambassadors between the courts of 'Abd al-Rahman (277-350/890-961) at Cordoba and Otto the Great (912–973) in Frankfurt. As already mentioned, Gerbert had gone to northern Spain in the 960s to learn Arabic mathematical sciences. A century later, Constantine (fl. 1065–85), a north African who had become a Benedictine monk, went to the monastery of Monte Cassino in southern Italy where he translated medical treatises from Arabic into Latin. These included the works of Galen (d. 129) and Hippocrates (ca. 460 BCE-ca. 377 BCE), which were to become the foundations of medical literature in the West.[48]

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These were, however, "harmless translations"; they neither impinged upon faith nor posed any problems for the new class of educated Europeans, who found a most attractive intellectual reservoir in Spain. The presence of Mozarabs,[49] a cosmopolitan culture, an ample supply of Arabic texts, and generous patronage combined to produce a translation movement which was to transform European learning over the course of a century and a half. While this translation activity was beginning, the reconquest of Spain further helped the process. The fall of Toledo in 1085 into Christian hands provided an excellent library which was exploited to the maximum extent during the next hundred years.

In an atmosphere rife with enthusiasm, adventure, conquest, patronage, and texts, there was no dearth of translators. Many Spaniards were fluent in Arabic. John of Seville (fl. 1133–42) translated a large number of astrological works, Hugh of Santalla (fl. 1145) translated works on astrology and divination, and Mark of Toledo (fl. 1191–1216) translated Galenic texts. Those who came from abroad included the Welshman Robert of Chester (fl. 1141-50), the Slav Hermann the Dalmatian (fl. 1138-1143), and the Italian Plato of Tivoli (fl. 1132-46).

The first translations were done without a scheme and merely for the sake of transmission of knowledge. But soon there arose need for translation of specific works whose references had been found in earlier translations, and these were done by able translators who searched for these texts. Among the greatest of these translators was Gerard of Cremona (ca. 1114–87), who came to Spain in the late 1130s or early 1140s from northern Italy in search of Ptolemy's *Almagest*. He found a copy in Toledo, where he remained until he could master Arabic in order to translate it.

But once in Toledo, Gerard also found a host of other texts that were simply astounding in character. Over the next thirty to forty years, he was to produce an enormous number of translations, no doubt with the help of a team of assistants. Thus, in addition to the *Almagest*, he is credited with the translation of al–Khwarazmi's *Algebra*, Euclid's *Elements*, and fifteen other works on mathematics and optics, fourteen works on logic and natural philosophy, including Artistotle's *Physics*, *On the Heavens*, *Meterology*, and *On Generation and Corruption*; he translated twenty-four medical works, nine of these were Galenic treatises and one was the *Canon of Medicine*, Ibn Sînâ's monumental work which was to remain as the mainstay of the medical curriculum all over Europe for at least four hundred years. The total number of books translated by Gerard of Cremona is between seventy and eighty, all of high quality because of his command of the languages as well as of the subject matter.

Let it be noted, even at the expense of digressing, that Gerard is comparable to Hunayn ibn Ishaq, the Nestorian Christian who is credited with a large number of translations, ranging from medicine, philosophy, astronomy, and mathematics to magic and oneiromancy,[50] from Greek and Syriac into Arabic. Out of the 129 titles enumerated by him in his *Risalah*, he himself translated about 100 into Syriac or Arabic or into both. The list is not exhaustive.[51] Likewise the medieval European translation movement can also be compared with the earlier Baghdad translation movement that brought a large number of Greek, Persian and Syriac texts into Arabic during a period extending from the eighth to the tenth century.

The Greco-Latin translation movement continued well into the thirteenth century. Just like the Greco-Arabic translation movement, it became more refined over time and as the technical terms and ability of the translators improved, many works were retranslated. William of Moerbeke (fl. 1260–86) was one such translator who provided a complete Aristotelian corpus to Latin Christendom along with translation of major Aristotelian commentators. He revised older translations where needed. He also translated a number of Neo-Platonic works.

With this background in mind, let us now examine how this received Greek and Islamic tradition was first to become the dominant intellectual force in Medieval West and then to give way to a new and opposing force out of which grew the worldview that was to produce modern science.

The first thing to note is the texts that were translated. The Medieval West seems to have been interested in medicine and astronomy at the beginning of the translation movement in the tenth and eleventh centuries. During the first half of the twelfth century, a large number of astrological works were translated along with enough mathematical works to allow a successful practice of astronomy and astrology. But medicine, astronomy and astrology in the Islamic civilization rested on a powerful metaphysical foundation, and they could not have been understood without understanding the foundations on which they were constructed. Thus, a large number of philosophical works were also translated in the beginning of the second half of the twelfth century; this activity continued into the thirteenth century and eventually all metaphysical works dealing with the foundations of Islamic scientific tradition in general, and medicine in particular, were translated into Latin. This meant the whole of the Aristotelian corpus, almost all of Ibn Sînâ (Avicenna, 370/980-428/1037) and Ibn Rushd (Averroes, 1126–98) and a host of others whose works were needed properly to understand and grasp the philosophical foundations of Islamic scientific tradition.

The common understanding is that Islamic scientific tradition arrived in Europe to lift it out of its so-called Dark Ages—if anything like that ever existed. Contrary to this understanding, it seems clear to me that the inner dynamics of European civilization had created the need to make use of the Islamic scientific tradition. Even a cursory glance at the works that were translated makes this point obvious.

Fortunately, one can reconstruct, with reasonable accuracy, what was translated, as well as when and by whom:[52]

• Ibn Sînâ was one of the first to be translated into Latin.

• The physical and philosophical parts of his *Kitab al-Shifa'* were translated by Dominicus Gundissalinus and John of Seville in Toledo in the 12th century.

• Alfred of Sareshel translated the chemical and the geographical parts in Spain at the beginning of the thirteenth century.

• *Al-Qanun fi'l-Tib* was translated by Gerard of Cremono in Toledo in the 12th century.

Among others who were translated between the 11th and the 13th centuries are the following:

- Ibn Rushd [as Averroes, by Micheal Scot, early 13th century]
- Ibn al-Haytham [as Alhazen, by more than one translator, end of 12th century]
- Al-Fârâbî [by Gerard of Cremona, in Toledo, 12th century]
- Al-Râzî [as Rhazes, by Gerard of Cremona and Moses Farachi, in Toledo and Sicily, in the 12th and thirteenth centuries]
- Al-Kindî [by Gerard of Cremona in Toledo, in the 12th century]
- Al-Khwârazmi [by Adelard of Bath and Robert of Chester in the 12th century]
- Jabir ibn Hayyan [by various translators in the 12th and 13th centuries]

This somewhat incomplete, but representative, list clearly shows that the European intellectual tradition was looking for a particular type of material; that it was not interested in the Islamic scientific tradition per se; that, in the dynamics of its own development, it needed to recover its own antiquity; that it found it in Aristotle's Arab home and recovered it. In this process, it came across Ibn Sînâ, al-Kindî and Ibn Rushd and took them as well—not as representatives of the Islamic scientific tradition but as commentators of Aristotelian corpus. Notice that those who were translated were chosen because of their importance for Aristotelian studies and not for their contributions to Islamic scientific tradition. Had the Islamic scientific tradition been the need and focus of European science, the list of translated material would not have been restricted to the above group of scholars and scientists, all of whom were profoundly interested in Aristotle.

Note the omissions in the above list: One obvious omission in this feverish translation activity is Abû Rayhân al-Bîrûnî (362-442/973-1050), Ibn Sînâ's able contemporary. His vast corpus of writing, which includes 180 works of varying length, embracing vast fields of knowledge, was not translated. This omission is more than accidental. Al-Bîrûnî was not translated because he was not needed at that stage by the European scientific tradition. In fact, a real appreciation for him had to wait until the twentieth century. And this is not an isolated example. Medieval Europe was equally uninterested in a host of other Muslim scientists whose contributions did not fit the requirements of the nascent science in Europe.

Islam and Modern Science

Let me conclude with a very brief note on the relationship between Islam and modern science. Taken as a whole, modern science is a product of Western civilization. Today, science and its more utilitarian offspring, technology, are eagerly sought by all cultures worldwide. But more than this hunger that modern science has produced in other civilizations and cultures, it is its sheer transforming force that is of importance for the science-and-religion discourse.

Taken as a whole, modern science is a product of Western civilization. Today, science and its more utilitarian offspring, technology, are eagerly sought by all cultures worldwide. But more than this hunger that modern science has produced in other civilizations and cultures, it is its sheer transforming force that is of importance for the science-and-religion discourse.

In its triumphal march, modern science has been able to obliterate all other ways of exploring nature, at least in a practical sense. It is this extraordinary global impact, modern science is a unique and unprecedented phenomenon in human history. The sheer magnitude of its reach, its ability to penetrate cultures as different as Islamic and Hindu, Chinese and those of the North American aboriginal nations, has no parallel in human history.

Briefly stated, the defining questions of contemporary science-and-religion discourse in the West revolve around a central core: The questions relating to the origin of the cosmos and of life, formulated in such disciplines as the cosmology, quantum physics, and evolutionary biology; the questions springing from the concepts of Nature, for example, Is Nature merely a huge coagulate of purposeless matter that has somehow emerged on the cosmic plane? Or is there any teleology observable in natural phenomena? Does God act in the physical world? Or are natural causes sufficient to explain everything, from the simple thunderstorm to the formation of galaxies.

For a meaningful discourse between Islam and modern science, one needs to view it from the perspective of the Islamic concept of nature taken as a whole and within its own matrix, which is defined by the revealed text, the Qur'ân. This is not an easy task because, as soon as one brings the revealed text into the contemporary discourse, there appears to be a hardening of attitudes and closing of doors because the science-and-religion discourse in the West is construed in the framework of theology and science and not in terms of the Bible and science, at least not in the mainstream. But perhaps the worst impediment is the parallel that is more likely to be drawn between such a stance and the presence of a fundamentalist strand in the West, which posits the Bible as a counterweight in the science-and-religion discourse. This fundamentalist strand is despised in the academic world. However, notwithstanding this difficulty, one cannot think of a genuine Islam and science discourse that is not rooted in the Qur'ân.

Likewise, Islam-and-science discourse cannot attain any degree of authenticity without its roots going back to the Islamic scientific tradition. What was Islamic in Islamic science? How was Islamic scientific tradition rooted in the Qur'ânic worldview and whatever happened to that tradition? Equally important are the epistemological considerations concerning the status of the Qur'ân in relation to modern science, and the nature and meaning of the so-called "scientific verses" of the Qur'ân. The concepts of cosmos, the nature of divine action, and God's relationship to created beings as defined by the Qur'ân cannot be ignored in any discourse on Islam and science.

Equally important for the discourse is an examination of the process of appropriation and transformation of the Islamic scientific tradition in Europe during the centuries prior to the emergence of modern science. One needs to look at the foundational structure of modern science and the relationship of its underlying philosophical structure to Islamic worldview. Then on the basis of these explorations, one can build models and methodologies for Islam and science discourse.

Works cited:

Bulliet, Richard. W. *Islam: The View from the Edge.* New York: Columbia University Press, 1994.

Contreni, John J. "Schools, Cathedral." In *Dictionary of the Middle Ages*, ed. by Joseph R. Straye, vol. 11, 59–63. 13 vols. New York: Scribner, 1982—.

Crombie, A. C. *The History of Science: From Augustine to Galileo.* New York: Dover Publications, 1995.

Gabriel, Astrik L. "University." In *Dictionary of the Middle Ages*, ed. by Joseph R. Straye, vol. 12, 282–300. 13 vols. New York: Scribner, 1982—.

Gabrieli, G. "Hunayn ibn Ishaq." *Isis*, vol. 4 (1924), 282–92.

Al-Ghazâlî, Abi Hâmid Muhammad b. Muhammad. *Ihyâ' ᶜulûm al-dîn.* Ed. Zain al-Dîn Abi'l Fadl al-ᶜIrâqî. (Beirut: Maktabatul ᶜAsriyyah, 1996.

_____. *al-Munqidh min al-Dalâl.* Beirut: Mu'assatul Kutub al-Thiqâfiyah, 1991.

_____. *al-Munqidh min al-Dalâl.* Trans. Richard Joseph McCarthy, Louisville, Ky.: Fons Vitae, 1980.

Herlihy, David. "Demography." In *Dictionary of the Middle Ages*, ed. by Joseph R. Straye. Vol. 4: 136-48. 13 vols. New York: Scribner, 1982—.

Huff, Toby E. *The Rise of Early Modern Science: Islam, China and the West.* Cambridge: University of Cambridge Press, 1993.

Kennedy, E. S. "Late Medieval Planetary Theory." *Isis*, vol. 57 (1962), 365-78.

_____ and Victor Roberts. "The Planetary Theory of Ibn al-Shâtir." *Isis*, vol. 50 (1959), 227-35.

Kraus, Paul. *Jabir ibn Hayyan.* 2 vols. Cairo: Imprimerie de L'institut Français d'archéologie Orientale, 1942.

Lattin, Harriet Pratt, ed. and trans. *The Letters of Gilbert with His Papal Privileges as Sylvester II.* New York: Columbia University Press, 1961.

Lindberg, David. *The Beginnings of Western Science.* Chicago: University of Chicago Press, 1992.

Makdisi, George. *The Rise of Colleges: Institutions of Learning in Islam and the West.* Edinburgh: Edinburgh University Press, 1981.

_____. "Muslim institutions of learning in eleventh century Baghdad." *Bulletin of the School of Oriental and African Studies*, vol. 24 (1961), 1-56.

McVaugh, Michael. "Constantine the African." In *Dictionary of Scientific Biography*, ed. by Charles Coulston Gillispie, vol. 3, 393–94. 17 vols. New York: Scribner, 1981–90.

Meier, F. "Nature in the Monism of Islam." In *Spirit and Nature*, ed. by Joseph Campbell. Princeton: Princeton University Press, 1982.

Meyerhof, M. Notes to "Tatimmat" by Abû'l Fadl al-Bayhaqî. *Osiris*, vol. 8 (1948), 122–217.

Ibn al-Nadeem. *Al-Fihrist.* Beirut: Dar El-Marefa, 1994.

Nasr, S. H. *Science and Civilization in Islam.* Cambridge: Harvard University Press, Cambridge, 1968.

Orme, Nicholas. *English Schools in the Middle Ages.* London: Methuen, 1973.

Peters, F. E. *Aristotle and the Arabs.* New York: New York University Press, 1968.

Pines, Shlomo. "What was Original in Arabic Science." In *Scientific Change*, ed. by A. C. Crombie, 181-205. New York: Basic Books, 1963.

Sabra, A. I. *Optics, Astronomy and Logic.* Aldershot, Hampshire, UK: Variorum, 1994.

Sa'dî, Lutfi. "A Bio-bibliographical Study of Hunayn ibn Ishaq al-'Ibadî." *Bulletin of the History of Medicine*, vol. 2 (1934), 409-46.

Said, Edward W. *Orientalism.* New York: Pantheon Books, 1978.

Saliba, George. *A History of Arabic Astronomy: Planetary Theories During the Golden Age of Isla.* New York: New York University Press, 1994.

Stahl, William H. *Roman Science: Origins, Development and Influence to the Later Middle Ages.* Madison: University of Madison Press, 1962.

Strohmaier, G. "Hunayn b. Ishaq al-'Ibadî." In *The Encycloepaedia of Islam,* ed. by Lewis et. al., vol. 3, 578–81. Leiden: E. J. Brill, 1986.

Tibawi, A. L. "Origin and Character of al-Madrassah." *Bulletin of the School of Oriental and African Studies*, vol. 25 (1962), 225-38.

Endnotes:

1. The exact date of the first revelation is almost impossible to ascertain. Many historians favor the reports that mention the 21st day of the month of Ramadan, thirteen years before the Hijrah, when Prophet Muhammad was forty years, six months and twelve days old (thirty-nine years, three months and twenty-two days according to lunar calendar). This is based upon the reports that the first revelation came on a Monday, in the month of Ramadan. This corresponds to August 20, 610 CE. Other reports suggest the 7th and 17th of the same Ramadan. Some reports mention the month of Rabi' al-Awwal of the same year, which would make it February 610.

2. Al-Qur'ân, 3:67

3. For example: "*Behold! In the creation of the heavens and the earth; in the alternation of the night and the day; in the sailing of the ships through the ocean for the profit of humankind; in the rain which Allah sends down from the skies and the life which Allah gives therewith to an earth that is dead; in the beasts of all kinds that Allah scatters through the earth; in the change of the winds and the clouds which they trail like their slaves between the sky and the earth; (here) indeed are signs for a people that are wise*" (2:164); "*Verily in the heavens and the earth are signs for those who believe. And in the creation of yourselves and the fact that animals are scattered (through the earth) are signs for those of assured faith. And in the alternation of night and day and the fact that Allah sends down sustenance from the sky and revives therewith the earth after its death and the change of the winds are Signs for those that are wise. Such are the Signs of Allah which We rehearse to thee in truth: then in what exposition will they believe after (rejecting) Allah and these Signs?*" (45:3-6); "*Those who hear the Signs of Allah rehearsed to them, yet are obstinate and proud as if they had not heard them, give them tidings of penalty grievous! And when they learn something of Our signs they take them in jest: for such there will be a humiliating penalty*" (45:8-9); "*This is (true) guidance: and for those who reject the Signs of their Lord is a grievous penalty of abomination*" (45:11). The word *âyah* literally means sign, but it also denotes a verse of the Qur'ân.

4. See Said.

5. See Huff.

6. Crombie, vol. I, p. 64. Crombie's seminal work, though now dated, has an interesting publication history. This Dover edition, first published in 1995 is an unabridged republication of the second revised and enlarged edition (1959), reprinted with corrections in 1970 and reprinted in one volume in 1979 by Heinemann Educational Books, London, under the title *Augustine to Galileo*, vol. I: *Science in the Middle Ages: 5th to 13th Centuries*; and Vol. II: *Science in the Later Middle Ages and Early Modern Times: 13th to the 17th Centuries*. Originally published in 1952 by Falcon Press Limited, London, under the title, *Augustine to Galileo: The History of Science A.D. 400–1650.*

7. Ibn al-Nadeem, p. 434.

8. The four orthodox schools of Islamic Law are named after their founders. The Malakite school was founded by the Jurist Abu ᶜAbdullah b. Mâlik b. Anas al-Ashabi (d. 178-9/795-96). The author of *Kitab al-Mu'tta,* he insisted upon the principle of public advantage (*istislah*), that is justice must not be sacrificed to theory. The Hanafite School of Law was founded by Abu Hanîfah al-Nuᶜman b. Thâbit (b. 80/699-700). Its main characteristic is the deductive extension of jurisprudence

by means of analogy (*Qiyâs*). Abû Hanifah insisted upon the right of preference (*Istihsan*) of a ruling suited to local needs. The Shafi'ite school of law was founded by Muhammad b. Idrîs al-Shafi'î (b. 151/767-68 in Gaza (?), d. 204/820 at Fustat), a student of Mâlik b. Anas. This school is based upon four principles: the Qur'ân, Hadîth, analogy (*qiyâs*), and the agreement of the Ummah (*Ijma*ʿ). And the Hanbalite school was founded by Abû ʿAbdallah Ahmad b. Muhammad b. Hanbal (b. 164/780, Baghdad; d. 241/855, Baghdad), a disciple of al-Shafi'î. He insisted on a more literal interpretation of the Qur'ân and the traditions of the Prophet, minimizing the value of analogy and agreement; he also compiled the *Musnad*, a collection of 30,000 traditions, arranged according to the Companions of the Prophet, who narrated them.

9. Divination through dreams.

10. To my knowledge no study exists that compares the impact of the life and activity of these two men, separated by three centuries but so comparable in their roles as transmitters of knowledge from one civilization to another. Hunayn's life is a fascinating story, both of one man's commitment to a life devoted to scholarship as well as of the vibrant currents that were flowing into the making of Islamic scientific tradition during his life. Biographical material on Hunayn has been collected by Gabrieli, by Lutfî Sa'dî, and in Meyerhof's notes to al-Bayhaqî's *Tatimmat* in *Osiris*, viii (1948), 122–217. For a short biographical note, see Strohmaier.

11. Bergsträsser, G, *Hunain ibn Ishaq über die syrischen und arabischen Galen-Übersetzungen* (Leipzig, 1925), quoted in Peters, p. 60-61.

12. Peters, p. 62.

13. Bulliet, p. 73.

14. Peters, p. 75 and references therein.

15. Some examples of this terminology are: *'ilm, 'aql, idrak, wahm, fikr, fiqh, anzar, tadabbur, ithbat, kalam, zann, haqq, batil, sidq, kidhb, yaqin, wahy, alam, wujud, 'adam, dahr, zaman, samad, Tawhid, shirk, khayr, sharr, fitrah, insah, bashar, iradah, 'amd, tawba, da'wa, qiyam, af'al, a'mal, tajalli, ma'rifa, nakira, majaz, haqiqa, mufassal, mujmal, qidam, hadath.*

16. That the universe has a purpose and has been created for a particular reason is asserted by the Qur'ân, which states: "We created not the heavens and the earth and all that is between them but for a just ends" (15:85); and "Not for [idle] sport did We create the heavens and the earth and all that is between them!" (21:16).

17. About three thousand articles, most of which are short treatises.

18. Known as Alkindus in Latin.

19. Known in Latin as Joannitius, he was a Christian scholar born in Hira who studied in Jundishapur and Baghdad under the famous physician, Ibn Maskawiah, and then went to Anatolia to study Greek. Though Hunain was a physician of considerable repute, he is most remembered for his exact translations from Greek and Syriac texts. He also wrote on astronomy, meteorology and philosophy.

20. Belonging to the Sabaen community of Harran, Thabit, like many others of his generation, was interested in Pythagorean mathematical and mystical tradition. At an early age, he left his community and, on his way to Baghdad, had the good fortune to meet the influential mathematician, Muhammad ibn Musa ibn Shakir, who took him under his patronage. Thabit gained access to the court and was later appointed as the court astronomer. Like many scientists of his time, Thabit's interests were not limited to just one discipline. He wrote on astronomy, number theory, physics, and other branches of mathematics.

21. His extraordinary work, *Algebra* (*al-Jabr wa'l-muqabalah*), gave its name to this science. He is credited with the introduction of Indian numerals into the Muslim world. (The West was to know these numerals as "Arabic" numerals.) He also wrote the first major work on geography and compiled astronomical tables which are recognized as the best in the Muslim world.

22. Muhammad ibn Zakariya al-Râzî, known in the West as Rhazes, the greatest

clinical physician of Islam (the so-called Arabic Galen), is credited with one hundred and eighty-four works by al-Biruni (362-442/973-1051) who made a special study of his writings. His medical works include the *Continens (al-Hawi), The Treatise on Smallpox and Measles*, known in Latin as *De Pestilentia* or *De Peste*). He also wrote an alchemical work, *Secret of Secrets*.

23. It is interesting to note that Pythagorean school also traces its roots to Prophet Enoch through the Sabaen community of Harran. Prophet Enoch (Idris in Islamic tradition) is regarded as the founder of the sciences of the heavens and of philosophy. Sabeans possessed a sound knowledge of astronomy, astrology, and mathematics.

24. Quoted and translated by Nasr, pp. 259-60.

25. These "hot" and "cold" natures of substances were also linked to Islamic medicine, in which each edible thing is characterized by a quality that is either hot, cold, dry, or humid. The elaborate system based on this division is still in practice in many Muslim countries with a remarkable degree of success.

26. For these concepts, I am indebted to the excellent discussion of Jabir's theory by S. H. Nasr in his ground-breaking *Science and Civilization in Islam*, pp. 258-68.

27. The metals are all, in essence, composed of mercury and coagulated with sulfur, wrote Jabir. They differ from one another only because of the difference of their accidental qualities, and this difference is due to the difference of their varieties of sulfur, which in turn is caused by variation in the earths, and in their expositions with respect to the heat of the sun in its circular motion. From *The Arabic Works of Jabir ibn Hayyan*, edited by E. J. Holmyard, vol. 1, part one (Paris: P. Geuthner, 1923), as quoted by Nasr, p. 267; See Kraus for the French version.

28. Meier, pp. 202-3.

29. See Pines, for example. This essay is included in *The Collected Works of Shlomo Pines* (vol. II), published in the *Studies in Arabic Versions of Greek Texts and in Medical Science (*Leiden: E. J. Brill, 1986). A significant contribution to pushing the date of the so-called decline of Islamic science has been made by research of E. S. Kennedy on Islamic astronomy in general and on the work of Ibn al-Shâtir in particular. See Kenney and Roberts; and Kennedy. Likewise, George Saliba and A. I. Sabra have made major contributions in developing a better informed picture of Islamic scientific tradition. See Sabra; and Saliba.

30. Huff, p. 212-13.

31. Ibid., p. 222

32. Sabra, p. 239. The book is a collection of articles from previously published material and page numbers of the original source have been retained. The article here referred to is entitled, "The appropration and subsequent naturalization of Greek science in medieval Islam: A preliminary statement," was first published in *History of Science*, vol. 25, pp. 223-43 (London: Science History Publications Ltd., 1987).

33. Al-Ghazâlî, *Ihyâ' culûm al-dîn*, and *al-Munqidh min al-Dalâl*.

34. Sabra, p. 222-23.

35. Ibid., p. 233.

36. Ibid.

37. See Makdisi, "Muslim institutions of learning in eleventh century Baghdad"; Tibawi; and Makdisi, *The Rise of Colleges*.

38. The Middle Ages extend over at least nine hundred years. Most historians take the end of Roman civilization in the Latin West (around 500 CE) as the beginning of the Middle Ages. The period from 500 to 1000 forms the early Middle Ages, and the period between 1000 and 1200 is generally classified as the transition period. From 1200 to 1450 is the "high" or "late" Middle Ages. Not all historians agree on these dates; but there is a consensus that by 1450, European Renaissance was well underway and the Middle Ages were over.

39. The Benedictine Rules were widely adopted within Western monasticism. The monastic life was primarily devoted to contemplation and worship, but there are enough

examples to dispel the generally held view that natural philosophy (as science was then called) was totally absent from monastic tradition. The well-known examples of Isidore of Seville (ca. 560–636) and the Venerable Bede (d. 735) testify to the presence of a tradition that was not wholly devoid of interest in nature and its study. Raised in Spain and educated by his elder brother, Isidore lived under Visigothic rule and became the Archbishop of Seville in 600. His works range from biblical studies to theology, literature, and history. Two of his works, *Nature of Things* and *Etymologies,* are monumental treatises of the Middle Ages which offer encyclopedic accounts of the whole range of classical learning. The *Etymologies* is a fascinating account of the nature of things on the basis of etymologies of their names. It exists in more than one thousand manuscripts and covers all branches of knowledge studied in the Middle Ages: theology, medicine, law, timekeeping (including the calendar), geography, agriculture, cosmology, mineralogy, and anthropology. For further details on Isidore, see Stahl, pp. 213–23.

40. Ibid., pp. 223–32.

41. For these details, see Lindberg, p. 185.

42. Ibid., and references therein.

43. See Lattin.

44. See Herlihy.

45. See Orme; and Contreni.

46. None of these dates can be taken as fixed. They represent a development in the history of Western Europe which spanned two centuries. For an excellent introduction to the history of universities, see Gabriel. Also see, Makdisi, *The Rise of Colleges*. Professor Makdisi has established that these universities were established on the pattern of Islamic *madrassah*s.

47. Mikdisi, op. cit.

48. See McVaugh.

49. Spanish- and often Arabic-speaking Christians.

50. Divination through dreams.

51. To my knowledge no study exists that compares the impact of the life and activity of these two men, separated by three centuries but so comparable in their roles as transmitters of knowledge from one civilization to another. Hunayn's life is a fascinating story, both of one man's commitment to a life devoted to scholarship as well as of the vibrant currents that were flowing into the making of Islamic scientific tradition during his life. Biographical material on Hunayn has been collected by Gabrieli, and by Sa'dî. See also Meyerhof. For a short biographical note, see Strohmaier.

52. See Crombie.

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Sacramental Water and the Challenge of Global Warming

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Process theologian Marjorie Suchocki, redefines sin as (1) the violation of relationships, (2) the absolutizing of the self and the denial of interdependence, and (3) rebellion against the creation. The challenge of our day is to update Christian liturgy, which celebrates our being "creatures created in the image of God," with a conscience, so that we will conserve and sacrifice for the good of creation, our children, and their descendents. Science tells us that we can reduce emission greenhouse gases in the future by using passive and active solar energy for heating and by generating electricity with windmills, semiconducting solar cells, and hydropower. Perhaps water's sacramental power can cleanse us from the unintended consequences of our past sins, give us new vision for the future, with the courage to recognize our interdependence within creation.

> The United Nations Environmental Program aims at transforming our fundamental relationship with the earth from one of destruction to redemption by combining our (A) knowledge of earth sciences with (B) the forces of spiritual values.
>
> —Adnan Z. Amin, Director, UNEP[1]

Knowledge of Earth Sciences

Can the sacramental power of water cleanse and motivate us to meet the challenges of global warming and flooding? In the past two decades, average temperatures have climbed as much as 7°F in the arctic. "The Big Meltdown" article in *Time Magazine*[2] reported that sea ice is 40% thinner and covers 6% less area than in 1980. Permafrost is becoming less permanent. The glaciers are retreating as we turn up the heat. If this and the melting of the polar icecaps continue, the sea level will rise and flood low-lying islands and peninsulas, such as Cape Cod and much of Florida. When this happens, the loss of valuable shoreline real estate will motivate us to take drastic measures. Unfortunately, it will take hundreds of years for any such measures to reverse the present trends. Climate models show that global warming is accompanied by weather extremes, such as excessive flooding and hurricanes.

In February 2001, the United Nations Intergovernmental Panel of Climate Change concluded:

> There is new and stronger evidence that most of the warming observed over the last 50 years is due to human activities.[3]

Every automobile owner is involved. For every 12,000 miles driven, the cumulative carbon dioxide emission in the exhaust is equivalent to the weight of the vehicle. Carbon dioxide is a greenhouse gas: it traps the sun's heat at the earth's surface like the glass in a greenhouse. The United States, with only 5% of the world's population, produces 23% of the world's carbon dioxide emissions. The United States emission of 6.6 tons of greenhouse gases per person per year is the largest in the world, twice that of Japan, and three times that of Sweden and Switzerland.[4]

In the 20th century, about half of all fossil fuel reserves have been depleted, resources that took hundreds of millions of years to form and are nonrenewable. Since the supply is limited, U.S. citizens can expect recent prices to continue in the long term. The tripling of oil prices from 1973 to 1980 together with waiting in line to buy gasoline got their attention and caused them to conserve and be more energy-efficient. For example, during this time, the average gas mileage of new passenger cars in the U.S. rose from 15 to 24 miles per gallon. Federal and state tax incentives increased the use of solar hot water heaters.

Since 1980, oil prices have been relatively stable. American have responded like a frog in a pot of water: if the water temperature is increased slowly, the frog will not sense danger, but will slowly cook. We are presently "cooking" in a state of complacency, with a false sense of safety. The fuel economy of vehicles has *decreased* from 26 miles per gallon in 1986 to 24 mpg at present, due to increases in light trucks and sport utility vehicles. Can the forces of spiritual values reverse this tend to meet the requirements of the Kyoto Accord that the US decrease its greenhouse gas emissions by 7% before 2010?

The Forces of Spiritual Values

Dr. Martin Luther King, Jr., who earned his doctorate in systematic theology from Boston University in 1955, once said:

> Through our scientific genius we have made the world a neighborhood; now through our moral and spiritual development, we must make of it a brotherhood. In real sense, we must learn to live together as brothers, or will perish together as fools.[5]

This statement, referring to the brotherhood between the races, is equally valid for human brotherhood and sisterhood with all the species and the communion with nature and the earth. Science, whose technology has unintentionally caused the environmental crisis, must nevertheless cooperate with religion to solve the problem. Science can give us the know-how, and religion the wisdom, motivation, and moral guidance.

Science says that emission greenhouse gases can be reduced in the future by using passive and active solar energy for heating and by generating electricity with windmills, semiconducting solar cells, and hydropower. Nuclear power plants do not emit greenhouse gases, although the disposal of nuclear waste remains a challenge. Fusion power, the combining of hydrogen nuclei to form helium and heavier atoms occurs naturally inside the sun, produces no nuclear waste. The problem being researched is how to make a container that does not melt at solar temperatures. New hybrid electric automobiles are more fuel-efficient than the present internal combustion engines. A way to generate energy without carbon dioxide is to explode hydrogen and oxygen; the only product is water. The problem is the safe storage of hydrogen fuel.

The cost of reducing carbon emissions from energy sources was studied by the Lawrence Berkeley National Laboratory.[6] It concluded that a sense of urgency resulting in the sale of tradable carbon emission permits, conservation, and increased research and development can enable the stabilization of increasing carbon emissions. The carbon emission tax gives an economic incentive to develop and favor nonpolluting sources of energy from the sun and the wind. The tax would also discourage the use of coal, which emits twice as much carbon dioxide as natural gas, as well as the pollutants in acid rain.

The industrialized countries could reduce carbon emissions at a cost of no more than 2% of the gross national product, according to an estimate of the U.N. Intergovernmental Panel on Climate Change. Science writer Chet Raymo in his column, "Science Musing," writes that "Bush is not looking at the big world" in his administration's formulation of environmental policy. Raymo spends about 2% of the value of his home in the Bahamas for hurricane insurance. He recommends that others do the same, "to protect ourselves against the potentially severe economic and environmental consequences of global warming."[7]

The religious community can motivate people to pursue such a plan. I am hopeful that water's sacramental power can cleanse us from the unintended consequences of humanity's past sins, give us new vision for the future, and the courage to conserve and sacrifice for the good of future generations. Since all of nature, including water is created by God, it has intrinsic value and should not be exploited. Since human beings were created in the image of God, they are stewards of creation. The story of Noah in Genesis 6 tells that God saw how wicked and evil everyone had become and was so filled with regret for having created them that God destroyed nearly all of living creatures with a Flood. The covenant with Noah after the Flood ended was that God would never do this again. We human beings need to uphold our responsibility in this covenant, by acting as better stewards and reducing the excessive use of carbon-emitting fuels—excessive use that may well result in a second Flood of our own making. We must do this "lest we perish together as fools." [5]

From a religious perspective, water has intrinsic value and power. Its use in the sacrament of baptism symbolizes cleansing from sins. Process theologian Marjorie Hewitt Suchocki, redefines sin as (1) the violation of relationships, (2) the absolutizing of the self and the denial of interdependence, and (3) rebellion against the creation.[8] This environmentally responsible interpretation of sin should be incorporated into liturgy as well as religious education. Environmental sin is that of omission—and emission—rather than commission, of ignorance and neglect rather than bad intention. Even when we have been knowledgeable, we have refused to change.

The Interreligious Sustainability Project of Metropolitan Chicago (supported by a grant from the United Church of Christ) is organizing discussion groups called Circles to address this problem. Their goals are (1) to pray, learn, reflect, and act to protect our children's and grandchildren's future, (2) to walk lightly on the earth and cut the use of natural resources by 10%. About two-thirds of greenhouse-gas emissions come from automobiles. Substantial savings can be achieved by trading an SUV for a gas-electric hybrid Honda Insight (61 mpg) or Toyota Prius (52 mpg). People can move closer to their workplaces, in order to reduce their commuting distance. Additional goals are (3) the creation of "Green Zone" churches whose energy management will serve as models for sustainability, and (4) the creation of effective regional transit systems to reduce traffic congestion and air pollution.

Here in Massachusetts, "Clean Air-Cool Planet"[9] is building an alliance of institutions, businesses, faith-based organizations, and individuals committed to reducing greenhouse gas emissions. It includes Shaw's Supermarkets, a company that has also reduced its energy usage, as well as the Tufts University Climate Initiative, which is committed to "meet or beat" the targets of the Kyoto Climate Accord. Tufts has accurately determined an emissions baseline and is working to bring its emissions down and to educate students and staff about climate change and energy efficiency. We can contribute by joining with them.

Martin Luther King's activism, as well as the sacrifice of his life for the brotherhood in which he believed, can be a model for what we must do to prevent environmental disasters. Anthropologist Margaret Mead has written:

> Never doubt that a small group of thoughtful, committed citizens can change the world. Indeed, it is the only thing that ever has.[10]

The resurrection power that Christians celebrate at Easter is not so much about dead bodies as about a spiritual transformation and

Science, whose technology has unintentionally caused the environmental crisis, must nevertheless cooperate with religion to solve the problem. Science can give us the know-how, and religion the wisdom, motivation, and moral guidance.

a "good news" that changed the world. The Resurrection changed the disciples of Jesus from a band of men and women fearing for their lives, transforming them into courageous and sacrificial ministers. Christian faith offers the transformative power for meeting the challenges of *our* moment in history. Part of this challenge must be to update our religious stories and liturgy, which celebrate our being created in the image of God, so that we will conserve and sacrifice for the sake of our children's children and the good of all creation.

Works cited:

Amin, Adnan Z. Open letter. In *Earth and Faith: A Book of Reflection for Action*, ed. by Libby Bassett, Kusumita P. Pedersen, and John T. Brinkman, 4. New York: Interfaith Partnership for the Environment/ United Nations Environmental Program, 2000. <http:// www.earthprint.com> .

Institute for Intercultural Studies. "Margaret Mead." Internet document, 2002:. <http:// www.mead2001.org>

King, Martin Luther, Jr. "Rediscovering Lost Values." In *A Knock at Midnight: Inspiration from the Great Sermons of Reverend Martin Luther King Jr.*, ed. by Peter Holloran and Clayborne Carson, 1-20. New York: IPM/Warner Books, 1998.

Koomey, Jonathan. "Costs of reducing carbon emissions in the U.S.: Some recent results." Talk presented at the Annual Meeting, American Association for the Advancement of Science, San Francisco, Cal. (February 20, 2001). Internet version, <http:// www.ornl.gov/ORNL/Energy_Eff/ CEF.htm>.

Linden, Eugene, "The Big Meltdown." *Time Magazine* (4 September 2000): 53-56.

Raymo, Chet. "Bush is not Looking at the Big World." "Science Musing" column. *The Boston Globe* (24 April 2002).

Suchocki, Marjorie Hewitt. *God, Christ, Church: A Practical Guide to Process Theology*. New York: Crossroad, 1982.

United Nations Intergovernmental Panel on Climate Change. *Climate Change 2001: The Scientific Basis*, ed. by J. T. Houghton, Y. Ding, D. J. Griggs, M. Noguer, P. J. van der Linden, and D. Xiaosu. Cambridge: Cambridge University Press, 2001. <http:/ /www.ipcc.ch>

United States Environmental Protection Agency. "Individual emissions." Internet document, updated 21 December 2001. <http://www.epa.gov/oppeoee1/ globalwarming/emissions/individual/ index.html>

Endnotes:

1. Amin.
2. Linden.
3. United Nations Intergovernmental Panel on Climate Change.
4. United States Environmental Protection Agency.
5. King, p. 4.
6. Koomey. Viewgraphs of this talk can be downloaded from the website, <http://enduse.lbl.gov/shareddata/CEF.JK.short.ppt>. The complete report can be downloaded from
7. Raymo.
8. Suchocki, p. 182
9. See the organization's website: <http://www.cleanair-coolplanet.org>
10. Institute for Intercultural Studies.

After receiving his Ph.D. in physics, Paul Carr led the Component Technology Branch of the Air Force Research Laboratory from 1967 to 1995. His lab did research and development on microwave ultrasound, surface acoustic waves, superconductors, and laser-activated antennas. He won a Science and Religion Course Award from the Center for Theology and the Natural Sciences for the philosophy course he designed and taught at the University of Massachusetts, Lowell, called "Science and Religion: Cosmos to Consciousness." Dr. Carr organized the Science-and-Religion Session of the International Paul Tillich Society Conference in New Harmony, Ind., in June 1999, and presented the paper, "Science and Religion: Original Unity and the Courage to Create," which was published in ZYGON: Journal of Religion and Science *in June 2001.*

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Aqua Pura: On the Purification of Religious Subjects and Aqueous Objects

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This paper is concerned with the significant symbolic and ritual applications of water in the Christian religion. The presence of water both actual and figural in the Christian tradition stretches back to pre-Christian Judaism and the history of water as it appears in the scriptural accounts. The history of the relation between water and Christian faith and ideas begins in the religions of Israel and extends continuously up to the present. This history is marked by the geography, ancient politics, and anthropology of water and water usage, such that the scriptures cannot be properly understood without taking these into account. In recent eco-theological reflection, water has become an object of renewed religious concern. The author reflects on how the Christian symbolism of water sets up a reciprocal relation between water as a religious, as well as a natural, resource.

"*Benedic, Domine, hanc aquam...*"
—consecration of water,
Roman Missal

As I went down to the river to pray,
studying about that good 'ole way
....
Lord show me the way."
—traditional American hymn

The nature and the characteristics of water lend themselves delightfully to religious sensibility: water as agent of cleansing, as drink, as vital fluid of plant and animal life, as precipitation in the form of rain, snow, sleet and dew, as a prime shaper of the geological surface, as shaper of geographical boundaries, as the medium of irrigation, as source of cooling and refreshment, as cause of natural disaster, as agent of death. All of these images emerge in the narratives of the Bible. In the scriptures, water mirrors heaven, it is the only abundant terrestrial element that also comes from heaven. Rain symbolizes divine favor and forgiveness (1 Kings 8:35-36), not only for the Covenant People but for all people, since God covenants with all creation. Indeed, water, a most everyday thing, is regarded as a divine gift when it falls from the sky and is a sign of divine activity in the world (cf. Job 38:28). Water is survival and is essential to crops, and to be lacking in it is nothing short of a plague, a sign of divine disfavor. Rain symbolizes the covenantal symbiosis of the divine and human: human beings till the soil, but only the Divine can water it (Isa 30:23). God and humans, created in God's image, together create agriculture.

Is it any wonder then that rain becomes a metaphor for divine righteousness and salvation?

> Shower, O heavens, from above,
> and let the skies rain down
> righteousness;
> let the earth open, that salvation may
> spring up,
> and let it cause righteousness to
> sprout up also;
> I the Lord have created it.
> (Isa 45:8)

Religious renewal itself finds metaphorical expression in the activities of agriculture and the theology of rain.

> Sow for yourselves righteousness;
> reap steadfast love;
> break up your fallow ground;
> for it is time to seek the Lord,
> that God may come and rain
> righteousness upon you.
> (Hos 10:12)

This is so much the case that in the great prophetic text from Joel concerning the sending of the Holy Spirit upon all people, the metaphor of pouring rain is used (Joel 2:23, 28-29; cf. Isa 44:3).

The wide variety of theological metaphors entailing water is striking. Water becomes essential for ritual cleansing throughout the Law of Israel as it is applied to priest and people alike. Employment of water for rinsing, cleansing, and purifying of body and objects of sacred and of everyday use abounds. Water purifies. Water also restores life, especially in the arid places of Israel's wanderings. And, of course, it is a major controversy over water that leads to the death of the great prophet Moses (Num 20:10ff). Repeatedly, the miracle of providing water from the rock of the desert inspired the praise of the scripture writers. Water is also the metaphor for the Spirit of God drenching the prophets and the people with purification and illumination. The prophet becomes like a fountain, gushing forth the spiritual word like an abundance of life-giving, purifying water. Water is so essential to the metaphor of the Spirit and spiritual renewal that those who are filled with the Spirit themselves become spiritual resources/sources like fountains or wells of water (Isaiah 58:11). Not to heed the prophet's word is to suffer a dearth of the divine Spirit. Spiritual "dryness" results. By the same token, the lack of water is a curse, the rationing of water as sign of oppression (cf. Lam 5:4; Ezek 4:11, 16-17). Waterlessness or water shortage becomes a sign of divine disfavor. But the eschatological hope of Israel includes both purifications with water and a pure river of water quenching thirst and watering the healing trees of paradise (Ezek 36:25; 47:12).

The New Testament continues much of this sense but reconfigures it through the sacrament of baptism. Jesus's forerunner John baptizes with water; but Jesus, he declares, with baptize with the Spirit and with fire (cf. Mt 3:11, par). Indeed, his baptizing the penitent with water is understood by him to be a preparation for the Spirit-baptism brought by Jesus (Jn 1:31). Jesus however is himself baptized simultaneous with water and the Spirit, the model of all Christian baptism (v. 16). The divine sourcing of water becomes applied to Jesus in conjunction with his disciples endangerment from the waves upon the Sea of Galilee because of the weather: they then confess his Lordship over the water (Lk 8:25). The fluids of life, water and blood, are both under Jesus's Lordship over all the elements of life, as signified in the wedding at Cana, with his miracle of turning water into wine (Jn 2:6ff). The prophetic metaphorical connection between water and Spirit and baptism making persons sources of the Spirit, i.e., gushing springs of living water, is supremely reflected in the conversation of Jesus and the woman at the Samaritan well (Jn 4:10, 13). In the great conversation with Nicodemus, "born of water and the Spirit" (Jn 3:5) when read in light of the water and blood that flowed from the crucified body of Jesus at his death (Jn 19:34) so that two dimensions of life are conveyed: water for the body, and God's Spirit for the human spirit (cf. 1 Jn 5:6, 8, in a most remarkable passage that symbolically unites water, blood, and Spirit). That those who are baptized in the Spirit become sources of the Spirit is itself modeled by Jesus when he declares:

> [L]et the one who believes in me drink. As the scripture has said, "Out of the believer's heart shall flow rivers of living water."
>
> (John 7:38)

This metaphor has particular ethical force in the Epistle of James where he condemns the hypocrisy of impure together with pure speech in Christian discourse (Jas 3:11). The use of water does have an empty ritual expression in the washing of governor Pilate's hands upon the victimizing crucifixion of Jesus (Mt 27:24). The prophetic sense of aquatic crisis returns in the book of Revelation. In this apocalyptic vision, the kinds of global pollution is clearly taken as a divine plague because of the radical injustice within the human community—nature itself has been degraded (cf. Rev 8:10-11; 16:4) and the great river dries up (16:12). When eschatological healing comes, it is prophetically symbolized by water, a river of life healing and quenching the thirst for righteousness (Rev 21:6;

22:1). Indeed, the connection with water and Spirit is complete:

> The Spirit and the bride say, "Come."
> And let everyone who hears say, "Come."
> And let everyone who is thirsty come.
> Let anyone who wishes take the water
> of life as a gift.
> (Rev 22:17)

Each of these senses pours through the chief watery symbol of the Christian faith: baptism. Because of this, the richness of water as a symbol must be explored, first as a hermeneutical key to developing religious understanding and then in terms of each discrete feature. But the analysis becomes reversed as well, due to the fact that eco-theology and the theology of nature have made the condition and quality of water and its natural sources a matter of religious concern.

The water's surface is pierced by the body that has "died" to the world, only to be pierced immediately again by the body that rises to new life in the Spirit.

Three liquids are found frequently in Christian sacramental ritual: water, wine, and oil. Baptism, the first and unrepeatable sacrament for the individual Christian unites her or him with the community of Christ. This sacramental act is the all-encompassing symbol of meaning, experience, and history in the life of the Church. The second fundamental sacrament, the Eucharist, representing the body and blood of Christ and his sacrifice, contains another liquid, wine.[1] The tradition of symbolizing the blood of Christ with wine that is consumed signifies a kind of purification that removes that which corrupts and condemns us, but it simultaneously provides illumination and regeneration. There is a third vital liquid in Christian ritual, oil, a blessed medium used in the anointing of the sick for their healing. With the water of baptism, there is yet another sense of purification of the conscience in that new life of faith that comes by the Creator Spirit of God. This sense is conveyed by water that comes from a "living source," such as a stream or a lake.

Water has been used in various ritual ways since the early church and is blessed in different ways. Upon occasion in the early church, worshippers would be sprinkled with holy water upon entering the church in a rite called, *hydrokometes* (introduction by water). Pope Leo IV required that all entering worship should be sprinkled with holy water and that the words be invoked over them: "*Omni die Dominico, ante missam, aquam benedictam facite, unde populus et loca fidelium aspergantur.*" By the high Middle Ages, the faithful would bring holy water home with them and sprinkle it upon all their livestock and possessions and even food as a popular rite of purification. Of course, most typically, the faithful apply the holy water to themselves upon entering a church, dipping their fingers in the receptacle known as the *cantharus* (ablution fountain). In all of the rituals, the Holy Spirit is invoked, since the water is received on account of its twin functions of purification and illumination. Thus, many "little baptisms" are received throughout the Christian journey by many of the world's Christians. This reflects the need for renewal of faith through the Holy Spirit with the simple prayer, "purify me, illumine me."

Baptism, at its most profound, becomes symbolically related to death. In the mode of immersion or, rather, submersion, the act of baptism becomes a ritual identification with the death and burial of Jesus's body.[2] The apostle Paul conveys this sense of being "buried with Christ" through baptism (cf. Rom 6:4). To be lowered beneath the waters' surface is likened to the lowering of the dead into the tomb—but in baptism only to be immediately drawn out of the water in the likeness of the resurrected body of Christ (v. 5). Beyond the image of washing, the body of water receives the body of the believer for a "burial" plunge. As with the surface of the ground, the liquid surface is a level below which the human body does not survive—indeed, it is placed beneath in order to remove its lifeless form from the presence of the living in the most respectful manner possible. The water's surface is pierced by the body that has "died" to the world, only to be pierced immediately again by the body that rises to new life in the Spirit. The body of water has come to represent the earth itself receiving her own in their death and burial. The earth is the place where the Lord demonstrates dominion over life as life-giver by redeeming life that cannot sustain the life which earth gives. And after all, earth is also a grave. Water and earth share earthliness, but the human body is called to transcend the dictates of earthliness and water serves as the medium to represent this hope in the sacramental act of baptism.

The reconciling Spirit, indeed, the Spirit that is reconciliation, so pervasive in creation that all life breathes by this breath,[3] is the very bond of the elements, the fundamental data/wisdom giving serendipitous order to everything. But in reference to the very special work of redeeming the human, made in the divine image, the Spirit becomes bath and drink for the individual. The purity and life–giving, life-rejuvinating nature of the Spirit is expressed in terms of water. It is almost as if the metaphorical imagination of the biblical authors sensed a profound relation between air and water. In a very general sense, the air is life and the water its congealed form. In one of the most profound texts, intended to make this connection, the apostle Paul writes in 1 Corinthians, "We were all made to drink of one Spirit,"—the breath of God. But this is anticipated in the image of all being baptized into one Spirit in Ephesians. Neither is reducible to the other; there is both a bathing and a drinking, as if one has come to an oasis in the midst of the death of devastation and desert and can plunge into a river flowing so abundantly and purely that purification and rejuvenation are simultaneous. Indeed, there is a reason why the seminal baptismal texts of scripture place the ritual at the riverside. There is a cleansing flow that both removes what it scours away and quenches thirst when one but opens the mouth. Christ's remarks to the woman at the well in the Gospel of John indicate that the new creation of rebirth in him turns the individual into a prophet and, therefore, a source of life, producing from within themselves "rivers of living water" to refresh others.

Rivers and baptisms are symbols not unique to Judaism and Christianity. The greater and smaller watery streams are universal geographical features invested with symbolic significance. Rivers are often regarded as living—even divine—currents in the midst of the divine earth, watering everything in their path. The flowing river brings life, even civilization and, when flooding, death. Virtually every great river entwined with human history has its own religious history has its own religious history, often hypostasized in ways that non-flowing bodies of water, such as lakes and seas, are not. Perhaps a river's desirable banks, upon which towns and cities are built, whose courses make navigation through these spots of civilization possible, where people both bathe and boat, are the cause of this personification. Rivers of life host and nurthre humanity in ways that seas and even lakes do not. But the fact that, fundamentally, baptism is originally a bath in a river whose courses cleanse and carry the off-scouring away most signifies our religious attachment to the river. To enter its current is to enjoy its purifying dynamic, as well as to draw upon its refreshment and sources of food and irrigation.

I want to focus upon two matters where the treatment of water needs a religious sensibility in order to consider "water rights"—not in the sense of who possesses them, but in terms of what rights are *due to water* from its human agents. Because pollution has become so per-

I want to focus upon two matters where the treatment of water needs a religious sensibility in order to consider "water rights"—not in the sense of who possesses them, but in terms of what rights are* due to water *from its human agents.

vasive in nature, the sacred roles have become reversed. Ritual purification can no longer be a metter solely for the benefit of a human subject, but it must encompass the very sacramental medium of the water itself. The first is purification by sterilization, either through intense heat or through chemical attack upon the microbial bloom in water. The second is a kind of "baptism of the baptismal element." Because the religious resource is also a natural resource, the natural resource itself now requires its own religious resource. "Water rights" takes on a whole new meaning.

Religious sensibility is required for the attending to water purity and purification. What we find is that mere environmental conservatism is itself looking for religious resources for the care of natural resources. When efforts to achieve water purity are pursued, this becomes a baptizing of the water for the sake of its mutual relations with us as subjects of baptism. Even less, some technological forms of reasoning have near-to-no sensitivity. Caution must be shown so that a notion of water purity is not guided by a logic of sterilization. This is not going to be easy, given that many pollutants in water occur naturally, or because the crowded planet has made for new incursions of naturally occurring pollutants to make their way into sources of water. Oversensitization must also be avoided where naturally occurring, non-toxic phenomena do not endanger the aquatic eco-system at any point, such as turbidity, flooding and droughts.

Below, then, are a number of theses I would propose for the beginning of a theology of water purification as a subset of eco-theology:

1. An aquatic hermeneutic that acknowledges an aquatic dimension to theological and philosophical expression.

2. A theological aquatics that expounds the richness of the aquatic metaphors of the Christian theological and liturgical tradition.

3. An aquatic spirituality full of the biblical metaphors connected with personal purification which will fuel a concern for the purity of the aqueous object. This makes for a sense of bi-directional purification according to a single religious sensibility. Just as by the Spirit of God there is a baptismal regeneration, so by an aquatic spirituality there is a regenerative baptism of water. One must think theologically about the chief types of pollutants: microbial, inorganic, herbicides and pesticides, organic, atomic.

4. A philosophical aquatics that recognizes how thinking about the earth is always also thinking about water.

5. An aquatic ethic, motivated by a sense of the rights of water as well as water rights, which will be inclusive of the full spread of the natural/created order. The use of rivers, as well as the building of reservoirs, is in view here. What to do with watershed areas as sources of natural water supply challenge the human community in essential ways. Preserving unique aquatic ecosystems and their imperiled inhabitants, along with meeting increased water demands, is a careful balancing act. "Water rights" will come to mean more than merely which human community has a right to water use. The water itself will have a "right" to purity and sustainability, whether in its flowing or non-flowing state. In addition, a universal aquatic concern applies here, recognizing the continuum that exists between surface water and ground water. Their purity is mutually conditioned. Regular hydrogeologic reporting is necessary for ascertaining the kind of use and misuse of aqueous objects that is taking place.

6. Water purity becomes an integral part of eco-theology and earth ethics. Water purity becomes a critical theological moment in the very practice of baptism.

7. An aquatics of wilderness management. Nothing reveals the symbiosis of the human steward of nature and the divine creator of nature more than wilderness management. This claim is made because wilderness is a highly technologized region, scientifically and culturally selected for its perceived pristine qualities and natural attractiveness. Of course, because of the migration of elements through weather and other means of interconnectedness, wilderness areas also require unique purification methods of their aquatic bodies. Ideas of "total water management" must include the most farsighted thinking about wilderness aquatics.

Recommended for further reading:

Ambrose of Milan. "On the Mysteries." In *Theological and Dogmatic Works*, trans. by Roy J. Deferrai. Washington: Catholic University of America Press. 1963.

Baartmans. Frans. *Apah, the Sacred Waters: An Analysis of a Primordial Symbol in Hindu Myths.* Delhi: B. R. Publishing Corp..1990.

Fape, M. Olusina. *Paul's Concept of Vaptism and Its Present Implications for Believers: Walking in the Newness of Life.* Lewiston, N.Y.: E. Mellen Press. c1999.

Glaeser. Bernhard. *Environment, Eevelopment, Agriculture: Integrated Policy through Human Ecology.* Armonk. N.Y.: M. E. Sharpe. 1995.

Golliher, Jeffrey, and William Bryant Logan, eds. *Crisis and the Renewal of Creation: World and Church in the Age of Ecology.* New York: Continuum. 1996.

Gottlieb, Roger S., ed. *The Ecological Community: Environmental Challenges for Philosophy, Politics, and Morality.* New York: Routledge. 1997.

Gregory of Nyssa. *The Soul and the Resurrection.* Trans. by Catharine P. Roth. Crestwood, N.Y.: St. Vladimir's Seminary Press, 1993.

Grim. John A., ed. *Indigenous Traditions and Ecology: The Interbeing of Cosmology and Community.* Cambridge, Mass.: distributed by Harvard University Press for the Center for the Study of World Religions. Harvard Divinity School, 2001.

Gustafson, James M. *A Wense of the Divine: The Natural Environment from a Theocentric Perspective.* Cleveland: Pilgrim Press. 1994.

Houck, Frederick A. *Fountains of Joy; or, 'By Water and Blood'.* St. Louis: Herder, 1931.

Jones. Larry Paul. *The Symbol of Water in the Gospel of John.* Sheffield. England: Sheffield Academic Press, 1997.

Karr, James R. *Restoring Life in Running Waters: Better Biological Monitoring.* Washington, D.C.: Island Press, 1999.

Kaza. Stephanie, and Kenneth Kraft, eds. *Dharma Rain: Sources of Buddhist Environmentalism.* Boston: Shambhala Publications, 2000.

Kim. Hee-Seong. *Die Geisttaufe des Messias: eine kompositionsgeschichtliche Untersuchung zu einem Leitmotiv des lukanishen Doppelwerks: ein Beitrag zur Theologie und Intention des Lukas.* Frankfurt am Main: P. Lang, 1993.

Lochbühler, Wilfried. *Christliche Umweltethik: schöpfungstheologische Grundlagen, philosophisch-ethische Ansätze, ökologische Marktwirtschaft.* Frankfurt am Main: P. Lang. 1996.

Nash. Roderick. *The Rights of Nature: A History of Environmental Ethics.* Madison, Wis.: University of Wisconsin Press, 1989.

Nasr. Seyyed Hossein. *Religion & the Order of Nature.* New York: Oxford University Press. 1996.

_____. *The Spiritual and Religious Dimensions of the Environmental Crisis.* London: Temenos Academy, 1999.

Northcott. Michael S. *The Environment and Christian Ethics.* New York: Cambridge University Press, 1996.

Reusswig. Fritz. *Natur und Geist: Grundlinien einer ökologischen Sittlichkeit nach Hegel.* Frankfurt: Campus Verlag, 1993.

Reymond, Philippe. *L'eau, sa vie, et sa signification dans l'Ancien Testament.* Leiden: Brill, 1958.

Smith, Mark J. *Ecologism: Towards Ecological Citizenship.* Minneapolis: University of Minnesota Press, 1998.

Tucker, Mary Evelyn, and John Berthrong, eds. *Confucianism and Ecology: The Interrelation of Heaven, Earth, and Humans.* Cambridge, Mass.: distributed by Harbard University Press for the Center for the Study of World Religions, Harvard Divinity School, 1998.

Van Dyke, Fred. *Redeeming Creation: The Biblical Basis for Environmental Ethics.* Downers Grove, Ill.: InterVarsity Press, 1996.

Wedderburn, A. J. M. *Baptism and Resurrection: Wtudies in Pauline Theology against its Graeco-Roman Background.* Tübingen: J. C. B. Mohr, 1987.

Zimmerman, Michael E., ed. *Environmental Philosophy: From Animal Rights to Radical Ecology.* Upper Saddle River, N.J.: Prentice Hall, 2001.

Works cited:

Ambrose of Milan. "On the Mysteries." In *Theological and Dogmatic Works*, trans. by Roy J. Deferrai. Washington: Catholic University of America Press, 1963.

Gregory of Nyssa. *The Soul and the Resurrection of Gregory of Nyssa.* Trans. by Catharine P. Roth. Crestwood, N.Y.: St. Vladimir's Seminary Press, 1993.

Hardy, Daniel. "The Spirit of God in Creation and Reconciliation." In *Christ and Context: The Confrontation Between Gospel and Culture*, ed. by Hilary D. Regan and Alan J. Torrance. Edinburgh: T&T Clark, 1993.

Endnotes:

1. Taking with utmost seriousness the death of Christ as sacrificial and salvific for all dying humanity, the entire sacrifice is summed up in scripture by reference to the blood of Christ, the fluid of life itself.

2. In the mode of aspersion, the act is a ritual application of the blood of Christ to the consecrated and regenerated Christian.

3. Cf. Hardy.

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Healing an Ailing Alliance: Ethics and Science Face the Ambiguities of Water

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Water-related problems are both scientific and ethical issues. The sciences and ethics are interdependent disciplines, and both are needed in an interactive alliance for adequate policy decisions on water and other ecological concerns. Water-related problems are generally linked to excess in what people take from and return to the waters. In this essay, the author outlines four moral norms that are foundational for remedial action on the waters of New England.

Problem and Purposes

Let me come immediately to my main argument: Water-related problems are not only geological, chemical, ecological, economic, and political issues; they are simultaneously ethical ones. The choices and policies on water in New England are, as commonly recognized, scientific questions. But they are no less major moral matters—in the basic sense that they entail value judgments about what is good and bad, right and wrong, for the welfare of both humans and other creatures in our relationships. Given this dual jurisdiction, a sound association between science and ethics is a practical necessity, and a present deficiency, for facing the quandaries of water and every other ecological concern, in New England or anywhere else.

Water-related problems in New England are similar to problems in many other places, though some differences are clearly significant. For example, New Englanders are not threatened, yet, by "water wars" among competing interests, as is true in the Middle East and parts of the American West. Children's deaths in New England are rarely related to contaminated water, as is the case, directly and indirectly, for 12 or 13 million children annually in poor nations. Our local agriculture is not normally jeopardized by the severe depletion of virtually nonrenewable aquifers, as is true in many places, from China to Colorado.[1] And we usually get plentiful precipitation—an annual average of about 40 inches, more or less, across the region, though none knows what climate change might portend. Still, New England's water problems are by no means trivial.

Water problems in New England are almost always linked to excess in one form or another—too much or too many of the goods we take from the waters, and a similar profusion in the wastes and contaminants we return to its pools and flows. This should not be surprising, since American culture can be described as the ethos of excess. Contrary to a common view, the cardinal vice of this age is not sexual in nature, except insofar as our species is reproducing too many for the good of our habitat and the rest of its inhabitants. Rather, the cardinal vice—and the one most likely to be overlooked—may be prodigality—and the injustices to our communities, other creatures, and future generations that the vice of prodigality produces.

To counter excess in the use of water and related goods, what is needed is the development and implementation of a new ecologically sensitive code of conduct for individuals and societies—one that respects the limits and shares the goods of life with all peoples and all species, now and for the future. This "new" ethics will be characterized by at least four norms or virtues: social equity, sustainability, "bioresponsibility," and frugality.

The development and implementation of these norms, however, depend on an intimate alliance between the empirical and evaluative disciplines. Unfortunately, this alliance is now ailing. But neither can function effectively without the other. We, therefore, need to enhance the cooperative bonds between the sciences and ethics on questions of public policy and appropriate practice.

In the title of this essay, I refer to the "ambiguities of water." Some will see this phrasing as a bit odd, but I think it is justified by how we experience water.

Water is a phenomenon with multiple meanings, along with a confusion of values and disvalues. Water is life-giving and life-taking, our benefactor and destroyer. Both scarcity and superfluity of water can be dangers to life, yet it is the fountain of life from which "all blessings flow"—our origins and the bulk of our body and blood. Water is a means of both purification and contamination, a healing power and a conveyer of pathogens, a sacramental medium, as in baptism, and a demonic force, as in a perfect or even imperfect storm at sea. Plentiful water is a prominent feature of the Promised Land (Deut 8:7), and even of Paradise, according to the Qur'an, where running waters and gushing fountains create the eternal gardens of delight. But super-plentiful water is also the weapon an angry god uses to eliminate the wicked, while causing a lot of collateral ecological damage, in the Genesis story of the Flood. Water can be a reason for joy and thanksgiving, as well as a catalyst for theodicies—depending on one's social and ecological location. What is good for some humans and some other species in certain contexts is bad for others in the same contexts. High water, for example, is good for those plants and animals that prosper in a floodplain, but it is bad for those towns and farms built, often foolishly, on that floodplain. Water is also both the great connector and divider, the barrier that stimulates the arts and sciences of bridge building and ship building, but also the one that shapes the boundaries of states and states of mind, such as Vermont and New Hampshire.

Water problems in New England are almost always linked to excess in one form or another—too much or too many of the goods we take from the waters, and a similar profusion in the wastes and contaminants we return to its pools and flows.

Water is also power—not only in the sense of energy from waterwheels and hydroelectricity, but also in the sense of controlling an essential resource and potentially depriving other persons and other species of their dues. Water as power was a theme in some old cowboy movies about desert waterholes and warring ranchers. It remains a significant political problem in various contexts, from international relations to municipal allocations. It is also a central ecological issue, especially in the form of anthropocentric imperialism vis-à-vis the rest of nature.

The recognition of these ambiguities can save theologies and ethics from some sentimental simplicities about water. They point to the complex problems and difficult dilemmas in making choices about water. They are another reason why both ethics and the sciences are important in making wise choices.

What Is Water?

What is water? Whenever I hear or see references to water, I frankly do not know the meaning of the word—unless the form and/or context is specified. We normally do not experience water as simply a chemical compound of two atoms of hydrogen and one of oxygen—the clear, colorless, odorless, tasteless liquid of the labs. Rather, we experience water usually with colors, odors, and tastes of various sorts. Water comes in a multitude of forms and places—all of which have shaped the landscapes, the weather, the cultures, the vocations, the foods, the mindsets, and lifestyles of New England and its various parts.

Water is not only the lakes, the rivers, the reservoirs (like the great Quabbin Reservoir), the falls, the bays, the open ocean, the aquifers, the kettles left behind by the glaciers, and the beaver dams—courtesy of the rodent who not only creates habitats for numerous species but also causes "property damage" for some members of our species. Water is also ski slopes, cranberry bogs, Jacuzzis, squirting fountains, canals, aqueducts, irrigation systems, pipes and pumping stations, ponds of treated and untreated wastewater, ice skating rinks, icy roads made passable with salt that contaminates our fresh waterways, as well as wooded watersheds that absorb precipitation, hinder flooding, and replenish and filter groundwater.

Each of these forms of water, moreover, has a set of moral problems associated with it. Let me, therefore, comment on several of these forms to introduce these ethical issues in New England.

Water is...

• both the gentle rain from heaven and the torrential Northeasters that erode sandy coasts, flood homes, and cause snow emergencies. Whatever the form, one result is runoff and the diverse contaminants that runoff carries—untreated sewage, oil from parking lots, leakage from tanks at gas stations, road salt, acid rain, fertilizers and pesticides, detergents and other chemicals, and metals like mercury—flowing and seeping into our streams, rivers, bogs, bays, harbors, and wells. Mercury-contaminated fish in some local ponds and rivers are unsafe for children and some adults to eat, according to the Massachusetts Department of Public Health. That includes Walden Pond of Thoreau fame.[2]

The main waterborne pollutants today are not from identifiable sources, such as factories and mills, though some still treat, or want to treat, the waterways as their private sewers. Rather, they are diffuse or "non-point" pollution from countless residential, business, and recreational sources. In an assessment of state efforts to control non-point pollution under a key provision of the Clean Water Act, the National Wildlife Federation gave Massachusetts and Maine a grade of B, Connecticut a C, Vermont and New Hampshire Ds. Rhode Island failed. No state in the U.S. received an A.[3] Non-point pollution reflects our excessive and ecologically careless lifestyles. It is the effluence of affluence.

Water is...

• vernal pools—small, temporary wetlands in the Spring, called potholes, sinks, or even puddles. Many species of wildlife are dependent on these vital habitats. They are a haven for amphibians, such as spring peepers and salamanders. But vernal pools are disappearing in New England—ditched and drained for "development" in the form of oversized homes, lawns, offices, factories, and malls. This habitat destruction is a significant factor in the decline of wood frogs, salamanders, and some birds.

Water is...

• various other wetlands—bogs, swamps, kettles, ponds, and marshes (freshwater and saltwater). They not only replenish and filter our water supplies; they are vital habitats for wildlife—indeed, some rare flora and fauna, as well as those indispensable but maddening mosquitoes who suck blood meals from us and, in turn, serve as the prime food for various birds, fish, and other animals. Like vernal pools, these habitats are the victims of our growing numbers, territorial expansion, and patterns of production and consumption. The intrusions on wetlands are often small and subtle, but the cumulative effect over time is that our wetlands have become only a small fraction of what they were historically.

Water is...

• the small streams, originally meandering, vegetated, natural drainage systems where groundwater discharges to the surface and surface water recharges groundwater. In many urban and suburban communities, streams have been transmuted into straight and eroded drainage ditches—culverts with little ecological significance but much proneness to flooding. The expansion of impervious material—roads, parking lots, houses, businesses, etc. replacing woodlands and wetlands that used to soak up rain and snow melt—adds to flooding problems in many places.

Often, stream "improvement" has been an anthropocentric rather than an ecological concept. It has not meant, for example, preserving or restoring wild conditions for the good of a biodiverse whole. Instead, it has meant enhancing the conditions for alien, stocked species, notably rainbow and brown trout, the preferred targets of elite "sportsmen," by such management practices as adding artificial deflectors and shelters, and by eliminating such indigenous predators as kingfishers, mink, herons, and turtles.[4] Elsewhere, the spectacularly beautiful native brook trout—which makes its rainbow cousin look drab by comparison—is often deprived of healthy habitats and even replaced by alien bullheads and perch.[5]

Water is...

• the numerous dams and the reservoirs they create, from Hoover Dam on the Colorado to the "old mill stream" of romantic nostalgia. There are about 75,000 large dams in the United States,[6] and nearly 3000 in Massachusetts.[7] The Connecticut River and its tributaries alone have about 1000 dams.[8]

These great barriers have transmuted the ecological character of our rivers and streams. They are great collectors of river-borne sediments that are often filled with pollutants. They create slackwater, while indigenous species may depend on running water. They have hindered or halted the great migrations of fish that leave the ocean to spawn in freshwater, especially when the dams are "absolute" barriers without "fishways."

Most of us know something about the tragic tale of the 560 or so dams in the Columbia River basin, particularly the four major dams on the Snake River, and the near-extinction of the once-abundant Pacific salmon species. What is not equally well known, however, is the effect of dams on New England's native fish. For more than 350 years, dams in New England have reduced or destroyed the migration runs of smelt, blueback herring, alewives, shad, and, of course, the now-rare Atlantic salmon in the Northeast.[9]

Some dams can be justified for human needs—perhaps hydroelectric power or the storage of consumer water supplies—and some long-standing ecological values, but a lot of dams are unnecessary and/or ecologically harmful. The now-breached Edwards Dam on the Kennebec River in Maine is a good example of one that is both unnecessary and harmful. The organization American Rivers runs the Rivers Unplugged Campaign, for breaching those dams that no longer serve significant purposes or their ecological costs outweigh the benefits. That seems like a sensible endeavor. But making these judgments in particular cases will require substantial scientific data and creative thinking in applied ethics.

Water is...

• so-called drinking water—on tap, no less. Most of it, of course, we don't drink; it goes for flushing, washing ourselves and our cars, watering lawns, filling backyard swimming pools (of which there are an estimated 86,000 ground-encased pools in New England[10]), and keeping golf courses green. Even when used for necessary purposes, however, waste is a prominent feature of how we use water.

In some communities, the demand for water by residences and businesses far exceeds the supply, especially during dry periods. Some aquifers have been nearly exhausted and smaller rivers, like the Ipswich, have been reduced to disconnected pools in summers, since they could not be replenished by aquifers. Thus, water scarcities have required water rationing at times, and we can anticipate more of the same in more places in the future.[11] Predictably, some of the affluent have escaped rationing by drilling private wells to ensure an exclusive and unrestricted supply of water. Of course. these wells draw from and draw down the common ground water system. This case is one of a number of social inequities in the distribution of water, reflecting the public's failure to understand that water is part of the commons to be shared fairly.

By all accounts, public drinking water in New England is usually stringently regulated and generally safe from various viruses, bacteria, and other pathogens like cryptosporidium and giardia. Municipal water treatment includes filtration and disinfection. Chlorine or a derivative is now the disinfectant of choice in most places in the U. S., because it effectively kills a variety of waterborne pathogens, including those that cause typhoid and cholera. Plus, unlike alternatives, chlorine has a residual effect; it provides enduring safety. Technically, chlorine is a pesticide.

The main waterborne pollutants today are not from identifiable sources, such as factories and mills, though some still treat, or want to treat, the waterways as their private sewers. Rather, they are diffuse or "non-point" pollution from countless residential, business, and recreational sources.

At this point, a major controversy starts. Chlorine combines with organic material in the water to create so-called disinfection by-products (DBPs), such as trihalomethanes, some of which may cause cancer or disrupt reproductive and developmental systems in humans and other organisms. The chlorine industry argues that there is no direct or conclusive evidence for these concerns at the low concentrations of DBPs in water treatment. Opponents, however, argue that harmful effects to delicate hormonal systems in humans and other organisms can occur at astonishingly low concentrations of parts per trillion. This debate is an important scientific and ethical issue. It involves significant questions about the appropriate interpretations of scientific data and justifiable precautions. There is no easy answer, but part of the solution for now is the persistent search for ecologically-friendly alternatives to chlorine and the minimal use of chlorine to the point of necessity. Minimization is an important ethical strategy for handling many dangerous processes and products.

Water is...

• bottled water—a $4 billion industry in the U.S., where more than one-third of Americans drink it regularly.[12] The imported elite brands—from France, Italy, and Sweden, for example—cost more than milk and juice. Profit margins are high.

Bottled water, however, may not be as clean and pure as the marketers suggest. The Natural Resources Defense Council (NRDC) concluded that bottled water is not necessarily safer or cleaner than most tap water in the U.S., especially in such places as New England. Indeed, the NRDC contends that tap water is stringently regulated while bottled water is inadequately regulated in the U.S. One brand of bottled water, for example, came from a well in the parking lot of an industrial site near a hazardous waste site.[13] *Consumer Reports* claimed that the main difference in taste among some brands came from the types of plastic in the bottles.[14] At least 25 percent of bottled water in the United States is little more than tap water, sometimes but not always further treated. As much as 70 percent may come from municipal sources. Aquafina, for example, Pepsi's water brand, does not come from the Italian or Swiss Alps, as the logo suggests. Nine of its 11 sources are municipal systems,[15] including the Ayer, Massachusetts, public water supply.[16] Glacier Valley, a brand distributed by some airlines, sports a foil label showing a snow-capped peak and a stream flowing through a conifer forest. The water comes, however, not from an icefield in Alaska, but from a bore hole in Connecticut.[17]

The sins of excess—gluttony really—represent a failure to learn the elementary lesson of ecology: There are no infinite bounties, no inexhaustible resources, no limitless systems. We need to share fairly with all within biophysical boundaries.

Nor is bottled water more environmentally responsible, considering the energy and material costs of processing, packaging, distributing, collecting, and recycling. In some places, moreover, the extraction of water for export may have adverse effects on local supplies.

My sense is that most bottled water is used not primarily because of health concerns—though that is a common argument and, in some places, a reasonable defense. Instead, the primary reason is that bottled water, especially the elite brands, is fashionable. It conforms to the values of our reference groups. It shows that we care enough to drink, and have enough money to buy, the very best, even upscale water.

Bottled water represents the privatization of hydration for the affluent. NRDC rightly fears that bottled water for the affluent "could undermine funding for tap water protection, raising serious equity questions for the poor."[18] The primary ethical challenge is to provide safe, public drinking water for everyone.

Water is...

• the ocean, which has been the primary shaper of everything from the foods and weather to the vacations and lifestyles of New England. Historically, the ocean was the foundation of the New England economy, particularly in shipping and fishing (including whaling). It remains a major factor in today's economy—not only in shipping and fishing, but also in recreation. The coasts and beaches are major magnets for vacationers—swimming, fishing, boating, driving off-the-road vehicles. In fact, some coastal fauna—such as shorebirds, both migrating and breeding species—have been declining as a consequence of human impositions on the shorelines, from both recreators and private property owners who control most of the coasts.

The ocean has been the prime sink for our carbons and contaminants, but it has also been the source of abundant foods, from seaweed to humpbacks. Some of the seafoods have been linked to New Englanders' identities, such as Maine lobsters. Yet, these links have been virtually severed in some cases, particularly in the case of the cod.

From the perspective of a New England environmentalist, the collapse of the cod fisheries is especially unnerving. The cod was central to the New England economy and its international trade from the 17th through the 19th centuries. In fact, the "sacred cod" hanging in the Massachusetts House of Representatives was the symbol of the Commonwealth. Cod were incredibly abundant on the banks off New England and the maritime provinces. In 1855, the Canadian Ministry of Agriculture, speaking of cod and related species, wrote, "Unless the order of nature is overthrown, for centuries to come our fisheries will continue to be fertile." [19]

Apparently, the order of nature was overthrown in little more than a century. The cod is close to being "commercially extinct" in some major fishing banks in the Northwest Atlantic, though there may be signs of some recovery in some places. The major fishing banks are closed or severely restricted. Tens of thousands of fishers and processors from New Bedford, Massachusetts, to St. Anthony's, Newfoundland, were left unemployed. The remaining fishers in New England turned to the few other species that had not yet been decimated, especially the spiny dogfish, a small shark once considered "trash," but now exported to England as a major source of fish and chips. But that species too has been caught excessively, and tighter limits have been imposed. Fishers are now "wondering if there is another species out there, like the dogfish, to keep them in business."[20]

The main problem is the same as Anne Plath McGinn's description of the plight of all the world's fisheries: "Put simply, too many fishers on too many boats with too many hooks or nets are taking too many fish from the sea."[21] That's true, but as McGinn also testifies, the fishers have been responding to too many consumers making too many demands on the sea.

With the decline of wild fisheries, aquaculture is a growing business in New England. The most prominent kind is farm-raised salmon, mainly European hybrids that are raised in cages on the Maine coast. They sometimes escape and may genetically threaten the survival of the already endangered Atlantic salmon. Moreover, on the public mudflats of some coastal towns in Massachusetts, shellfishers plant beds of oysters and quahogs under grants from the towns. Complaints about nepotism and favoritism arise over the allocation of plots, but the more serious question is the effects on the mudflat ecosystems by propagating one species and protecting it from its natural predators, including birds and crabs.[22]

I could continue these lamentations at length, but the central point would remain the same: The primary moral offense on water is excess—excess in what we humans take from and do to the water, excess in the wastes and emissions we return to the water, and excess in our transformations of water systems. All of these excesses give rise to forms of injustice—to other people, other species, and future generations. Our excesses on water are really excessive regard for ourselves at the expense of others. We are grasping more than our due and thereby depriving others of their dues. In classical Jewish and Christian thought, of course, this is the essence of sin—and so it should be regarded. The overuse and abuse of water are sins—and far more serious ones than those that generally preoccupy the churches. The sins of excess—gluttony really—represent a failure to learn the elementary lesson of ecology: There are no infinite bounties, no inexhaustible resources, no limitless systems. We need to share fairly with all within biophysical boundaries.

Interdependence of Science and Ethics

To challenge these excesses on water and their resultant injustices, one of the most important resources will be an alliance between ethics and the sciences. I am not referring to an alliance simply between scientists and ethicists. Water issues, like war, are too important to be left to professional elites. Rather, I am suggesting that everyone must take the relevant sciences and ethics seriously in facing problems of water. On choices and policies about water, these sciences and ethics are interdependent disciplines.

The problem, of course, is that ethics and the sciences lean toward isolationism—hardly a unique inclination among specializations with separate sources, methods, languages, etc. Yet, we need to promote a partnership between ethics and the relevant sciences based on mutual need in support of a common cause. The relationship that I commend is not mere cooperation, though that in itself would be appealing, but also what James M. Gustafson calls "interaction," in which ethics and the sciences are reciprocally shaped through sharing.[23]

On one side, the sciences are essential resources for ethics (and theology, too). Ethics must be informed by the best available scientific data and analyses in order to make sound evaluations and choices. It is impossible, for example, to do ecological ethics, even at a general level, without an adequate understanding of the fundamentals and some particulars of ecological dynamics. Without this understanding, ecological ethics is likely to be reduced to romantic fluff or spiritual musings, as if, for example, predation does not exist. In fact, that is precisely what has happened in some so-called eco-ethics and eco-theology in religious circles. They are not rooted empirically, and, consequently, they are largely irrelevant to such specific issues as the use and distribution of water.

But ethics also depends on the sciences in a deeper way than mere assistance in the application of independent moral norms. Those of us who are ethical naturalists find our norms in nature, in the sense that the empirical realm is the source of our standards and the place where we test their validity, and revise them as necessary. We discover and defend what we ought to be and do, in general and in particular situations, in view of the values and virtues, rights and responsibilities, principles and practices that contribute to the optimal well-being of our kind and other kinds in relationships. As a contemporary example, the "new" virtues of sustainability and bioresponsibility—that is, concern, respectively, for justice to future generations and to non-human life—have come to us not as handouts on a mountaintop; they are emerging through reflections on our experiences with a variety of environmental vices. On this assumption, ethics must be open to all cultural wisdom, especially the relevant sciences, to discover what helps and hinders social and ecological well-being. Theologically, beyond the historical sources of moral insight in scriptures and traditions, the continuing revelations of the divine moral will can be discerned in the totality of existence, including in scientific knowledge.[24]

On the other side, the sciences are equally dependent on ethics. But the recognition of this dependency is frustrated by a debilitating myth about the relationship. A common assumption, in both popular and some scientific circles, is that "real" science is morally neutral or value-free. A sharp dichotomy between facts and values is assumed. Science is considered to be objective, and ethics to be subjective—even arbitrary and relative. Science is thought to be rational and impartial, ethics to be emotional and preferential. Science is considered to be quantitative, ethics to be qualitative. Science is said to be empirical and experiential, ethics to be intuitive and existential. These frequently encountered dichotomies seriously distort both the sciences and ethics.

They distort ethics in several ways. For example, they identify ethics in general with particular ethical theories, such as emotivism or relativism, which most ethicists reject vigorously. They overlook the fact that ethics, too, is a rational enterprise, concerned with consistency, coherence, comprehensiveness of interpretation, and fruitfulness in advancing social and ecological well-being. Ethics is also empirical in orientation in naturalistic interpretations.

Equally, this myth distorts scientific enterprises in important ways, initially by missing the inherent moral character of science. The practice of the sciences is impossible without certain moral commitments and truncated without others. These include honesty in the selection and interpretation of data; trustworthiness and fairness in the community of peers; fidelity to the rules of rationality and evidence; tolerance of interpretive diversity; freedom of inquiry; corrective dissent from prevailing paradigms; and cooperation in the search for knowledge. Even the much-celebrated scientific "objectivity" is, as Langdon Gilkey, observes, a "moral and spiritual achievement."[25] Scientists are moral subjects in a moral guild, or else science itself is impossible, constricted, or corrupted.[26]

Moreover, on questions concerning social and environmental policies and projects, moral values pervade the purposes, definitions, methods, and assumptions of scientific studies. Whenever, for example, scientists talk of what is an "acceptable risk" or "safe dosage" of chemical compounds in drinking water, or whenever they express alarm about the effects of dams on migrating fish, or counsel calmness about pesticides, or make any recommendations on public policy, they are no longer functioning strictly as technical authorities. They are also acting as moralists, making value judgments about what state of being is better or worse than another. They have exceeded the bounds of their formal competencies, often without a consciousness on their part or the public's of this significant shift in roles. Indeed, the pretense that science itself and science-based findings are value-free can serve as a "useful" device for scientists to disguise the promotion of their value preferences.[27]

The danger to scientific integrity in these contexts is not the expression of moral values. That is inevitable. It is, rather, the expression of (1) invisible values—ones that are not made clear and explicit, and (2) nonviable values—ones that are in some way ethically deficient or indefensible. This danger is especially evident in economic cost-benefit analysis (CBA), so dominant today in science-based public policy decisions on water and everything else. CBA aspires to the transcendence of moral values, perceiving itself as an alternative to ethics. In reality, however, it reflects a distorted set of values. Arbitrarily, CBA makes the assumptions that moral values can be reduced to market values, and that moral values are not objectively real but simply subjective preferences. CBA, for example, calculates the values of wildlife and wildlands by measuring human economic preferences (our "willingness to pay"). In so doing, it makes the moral assumption that only human interests count, and not the intrinsic value of other lifeforms. One of the indispensable service functions of ethics in an alliance with the sciences is to uncover the hidden values and norms in scientific assumptions, methods, goals, and controversies, and to help sort out the good values and norms from the bad.

Whenever scientists talk of what is "safe dosage" of chemical compounds in drinking water, or whenever they express alarm about the effects of dams on migrating fish, or counsel calmness about pesticides, or make any recommendations on public policy, they are no longer functioning strictly as technical authorities. They have exceeded the bounds of their formal competencies, often without a consciousness on their part or the public's of this significant shift in roles.

Usually, my primary complaint against these disguised moral arguments in so-called scientific recommendations is that the values and norms assumed are insufficiently inclusive and comprehensive—that is, they fail to give adequate consideration to all parties with stakes in an outcome, and they fail to incorporate all relevant moral elements.[28] The sciences need ethics at this point in order to make necessary moral judgments intentionally and well, rather than unconsciously and poorly. Ethics, informed and even reshaped in interactions with the sciences, can return the favor. Ethics offers essential guidance to prevent the violation of human and biotic rights in the goals and methods of particular scientific projects, and to prevent abuses of science itself, through, for example, plagiarism, fabrication, and political or economic manipulation. Ethics and the sciences are interdependent; to deal with water and other problems, we need both in an intimate, interactive alliance.

Four Norms of Alliance

One question remains: What is the ethical substance that should be developed and implemented in an alliance between ethics and the relevant sciences on water problems? I shall comment briefly on four norms or virtues that are essential for remedial action on water. These virtues are standards for character formation and social transformation. Three, in fact, deal with different dimensions of distributive justice, and the fourth is an instrument for the other three. Other norms are also relevant, but these are sufficient for my purposes in this essay.

1. Social Equity

Social equity is the inter-human form of distributive justice—the ethical process of apportioning benefits and burdens, on the basis of relevant similarities and differences, in order that all parties with stakes in an outcome receive their fair share. This norm is regularly violated in water distribution in New England. The rich and powerful, both individuals and corporations, often get the most benefits and bear the fewest burdens. They have greater access to water, they waste more, and they pollute more, but they usually pay less in proportion to their use and effects. Water is not a private commodity; it is part of the commons. To combat classism, fair standards and charges need to be developed for the distribution and use of water.

2. Bioresponsibility

Bioresponsibility is the extension of the covenant of justice to include all lifeforms. It means valuing other species for their own sakes, as ends in themselves, not simply as instrumental values—"raw materials," "renewable resources"—for human needs. The violation of this norm is a central feature of the way we use and abuse water.

Bioresponsibility is recognizing that other species are entitled to a fair share of water and other planetary goods. Of course, trying to define the practical meaning of "fair share" is at best an extremely difficult task, particularly when humans in a predatorial biosphere must destroy other lifeforms in order to survive and create. Yet, a "fair share" is a concept that we must struggle to define in order to stifle the anthropocentric imperialism that is so harmful to the rest of nature. We humans have already used far more than any reasonably defined fair share of the world's goods, including water. We must henceforth seriously limit our economic production and consumption, as well as our reproduction, to allow much more room for the thriving of wildlife and wildlands along with the thriving of human communities. Water is not only a resource for us; it is also a resource and a variety of habitats for other species.

3. Sustainability

Sustainability is living within the regenerative, absorptive, and carrying capacities of our planetary places *indefinitely*. It is a covenant of justice with future generations of our kind and other kinds until the end of the age. As such, sustainability seeks a balanced distribution between present and future generations.

For example, sustainability depletes so-called renewable resources, such as fisheries, no more than the rate of their regeneration—and preferably far less—to respect the values of otherkind. Sustainability pollutes no more—and preferably far less—than can be naturally assimilated. Sustainability says that it is wrong to disregard and discount the interests of future generations in the use and abuse of water.[29]

4. Frugality

Frugality is probably the most feared and neglected norm in modern morality. Some economists consider it a "vice," because it hinders economic growth. It is the most subversive of the virtues, because it is a revolt against the most sacred values of prodigal societies. Yet, solutions to every problem associated with water in New England, and maybe every other social and environmental problem, depend on the revival of this classical virtue, and its reformation from a strictly personal trait into a social norm. Frugality is an antidote to the gluttony that is corrupting the water and the land.

Frugality means moderation, thrift, even temperance (in a classical, not evangelical sense). It is morally disciplined production and consumption. It is a "middle way" that struggles against both profligacy and poverty. It is not a world-denying asceticism, but rather an earth-affirming and enriching norm that delights in the less-consumptive joys of the mind and flesh, especially the enhanced lives for human communities and other creatures that only constrained consumption can make possible on a finite planet. Frugality is an expression of love, and a necessary condition of social equity, bioresponsibility, and sustainability.[30]

Conclusion

In the final analysis, we need to think of all water as holy water—holy without benefit of clergy and their blessings. In all its ambiguity, all water is what the Roman Catholic bishops of the Pacific Northwest called the Columbia River watershed: "a sacred commons" to be shared and cared for by all.

Water is a sacred object and the habitat and resource for countless sacred subjects. Like all things holy, water should be treated reverently and caringly, and used only fairly and frugally. Otherwise, it should be left untouched for the good of all.

Works cited:

Abraham, Yvonne. "The Pool—No Longer So Cool." *The Boston Globe*, 10 April 2001.

Buchsbaum, Robert. "Up the Dammed Fishway." *Sanctuary* 38 no. 4 (March/April 1999): 13-15.

Contrada, Fred. "The River Runs Free." *Sanctuary* 38 no. 4 (March/April 1999): 18.

Daley, Beth. "Dogfight Brewing." *The Boston Globe*, 9 August 2000.

Duncan, David James. "Salmon's Second Coming." *Sierra* (March/April 2000): 32.

"Fish Consumption Warnings in Northwest Communities." *The Boston Globe*, 18 March 2001.

Gilkey, Langdon. *Nature, Reality, and the Sacred: The Nexus of Science and Religion*. Minneapolis: Fortress Press, 1993.

Graf, William L. "Dam Nation: A Geographical Census of American Dams and Their Large-scale Hydrologic Impacts." *Water Resources Research* 35 no. 4 (April 1999): 1305-11.

Graham, Loren R. A. "The Multiple Connections between Science and Ethics: Response to Stephen Toulmin." In *The Roots of Ethics: Science, Religion, and Values*, ed. by Daniel C. Callahan and H. Tristram Engelhardt, Jr., 425-38. New York: Plenum Press, 1981.

Gustafson, James M. *Intersections: Science, Theology, and Ethics*. Cleveland: Pilgrim Press, 1996.

"It's Only Water, Right?" *Consumer Reports* 65 no. 8 (August 2000): 17-22.

Keese, Susan. "Battling Over Bottom Feeders." *Sanctuary* 39 no. 6 (July/August, 2000): 7-9.

Kummer, Corby. "What's in the Water?" *New York Times Magazine* (30 August 1998): 60.

Kurlansky, M. *Cod: A Biography of the Fish that Changed the World*. New York: Walker, 1997.

Ladd, John. "Are Science and Ethics Compatible?" In *The Roots of Ethics: Science, Religion, and Values*, ed. by Daniel C.

Callahan and H. Tristram Engelhardt, Jr., 373-402. New York: Plenum Press, 1981.

McGinn, Anne Plath. "Promoting Sustainable Fisheries." In *State of the World 1998*, ed. by Lester R. Brown, 59-78. New York: W. W. Norton, 1998.

Meyer, Karl. "Living Upstream." *Sanctuary* 38 no. 4 (March/April 1999): 7.

Nash, James A. "Seeking Moral Norms in Nature: Natural Law and Ecological Responsibility." In *Christianity and Ecology*, ed. by Dieter T. Hessel and Rosemary Radford Ruether, 227-50. Cambridge, Mass.: Harvard University Press, 2000.

_____. "Humility as Predisposition for Sustainability: The 1999 Ian Barbour Lecture, NASTS." *Bulletin of Science, Technology and Society* 19 no. 5 (October 1999): 359-64.

_____. "Moral Values in Risk Decisions." In *Handbook for Environmental Risk Decision Making: Values, Perceptions and Ethics*, ed. by Richard Cothern, 195-212. Boca Raton, Fla.: CRC Press/Lewis Publisher, 1996.

_____. "Toward the Revival and Reform of the Subversive Virtue: Frugality." *The Annual of the Society of Christian Ethics* (1995): 137-60.

Nickens, T. Edward. "Return of a Native." *National Wildlife* (Oct./Nov. 2001): 30-33.

"NWF Priority: Safeguarding America's Waterways." *National Wildlife* (April/May 2001): 49.

Olson, Erik D. *Bottled Water: Pure Drink or Pure Hype?* Washington: NRDC, 1999. Internet version: <http://www.nrdc.org/water/drinking/bw/bwinx.asp>

Palmer, Thomas. "Ghost Fish." *Sanctuary* 38 no. 4 (March/April 1999): 3-5.

Postel, Sandra. "Redesigning Irrigated Agriculture." In *State of the World 2000*, ed. by Lester R. Brown, 39-58. New York: W. W. Norton, 2000.

Preer, Robert. "Questions about Safety Help Push Sales of Bottled Water." *The Boston Sunday Globe*, 14 May 2000.

"Saving Our Water." Three-part series. *The Boston Sunday Globe, Northwest Weekly* section (7, 15, and 21 May 2000).

Thompson, Douglas M., and Gregory N. Stull. "The Use of Habitat Structures in Channel Restoration: A Historical Perspective." Unpublished paper. Dept. of Physics, Astronomy, and Geophysics, Connecticut College, 2001.

Toulmin, Stephen. "How Can We Reconnect the Sciences with the Foundations of Ethics?" In *The Roots of Ethics: Science, Religion, and Values*, ed. by Daniel C. Callahan and H. Tristram Engelhardt, Jr, 403-423. New York: Plenum Press, 1981.

Endnotes:

1. Postel.

2. "Fish Consumption Warnings in Northwest Communities."

3. "NWF Priority: Safeguarding America's Waterways."

4. Thompson and Stull.

5. Nickens.

6. Duncan. Large dams of "environmental consequence" are defined as those of 6 feet or higher, with 50 acre-feet of storage, or more than 25 feet, with 15 acre-feet of storage, "and those of any size that pose a significant downstream threat to human lives or property" (Graf). Smaller dams are far more abundant.

7. Contrada.

8. Meyer.

9. See Palmer, Buchsbaum, as well as the other essays in the March/April 1999 issue of *Sanctuary*, entitled "Over the Dam."

10. According to the National Spa and Pool Institute, quoted in Abraham.

11. See the excellent series, "Saving Our Water."

12. Olson, ch. 2.

13. Ibid., ch. 1.

14. "It's Only Water, Right?"

15. Kummer.

16. Preer.

17. Kummer.

18. Olson, Executive Summary and ch. 1.

19. Kurlansky, p. 33. Much of what I say about New England fisheries has been shaped by this fascinating book.

20. Daley.

21. McGinn, p. 65.

22. Keese.

23. Gustafson, pp. 68-72, 137-38.

24. For a fuller interpretation of ethical naturalism, see my "Seeking Moral Norms in Nature: Natural Law and Ecological Responsibility," in *Christianity and Ecology*, ed. by Dieter T. Hessel and Rosemary Radford Ruether (Cambridge, Mass.: Harvard University Press, 2000), 227-50.

25. Gilkey.

26. For a fuller interpretation, see Nash, "Moral Values in Risk Decisions." Scientific methods, interestingly, cannot confirm these moral preconditions of science. Any effort to do so begs the question, since even the process of validating values, such as honesty, would need to assume the validity of the values. The moral foundations of science depend on philosophical, even metaphysical, justifications.

27. Graham, p. 432. See also Toulmin; Ladd.

28. Some of the veiled—or open—moralizing among scientists is, however, very good. On some questions in ecological ethics, such as the precautionary principle, I have learned more from the rigorous criteria proposed by some scientists than I have from the ethereal principles offered by some ethicists.

29. For a fuller interpretation of sustainabiliy, see Nash, "Humility as Predisposition for Sustainability."

30. For a fuller interpretation, see Nash, "Toward the Revival and Reform of the Subversive Virtue: Frugality."

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This essay was presented on 26 April 2001 as the keynote address for the Second Annual Science and Religion Colloquium, "Water in New England: Religious and Scientific Perspectives," sponsored by the New England Faith and Science Exchange, the Boston Theological Institute, and Boston University School of Theology.

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Consecration and Conservation: Walden Pond as a Sacred Site

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This essay explores the dynamic interplay between religion, science, and the environment by focusing on Henry David Thoreau's consecration of Walden Pond and the subsequent history of the site's conservation as a natural and cultural shrine. The author suggests that consecrated natural sites such as Walden enable us to get beyond the overdrawn dichotomies of nature/culture, sacred /mundane, and inherent/ascribed and provide fresh insights for the study of religion and ecology.

The developing religion-and-ecology movement is one of the more exciting and timely examples of multidisciplinary dialogue about pressing social and environmental issues. With this essay, I aim to contribute to this dialogue by examining the intersections of religion and ecology in the particular case of Walden Pond in Concord, Massachusetts. Considering Henry David Thoreau's scientific and literary consecration of the pond in the mid-nineteenth century and the subsequent maintenance of Walden as a sacred site or historic shrine raises important questions concerning the relationship between religion and the environment. Can a particular site be demarcated as sacred for ecological purposes? If so, is its sacredness ascribed or inherent? What are the relative ecological implications of consecrating a place? And what, if anything, does this particular case study teach about alternative understandings of science, religion, and the environment that might aid in addressing today's social and ecological crises?

Thoreau's Experiment

Thoreau was deeply engaged with both science and metaphysics, and his writings demonstrate his commitment to natural history, the emerging natural sciences and his own "material faith." Combined, these interests culminated in Thoreau's endorsement of what he called "con-science," a form of "*moral* knowledge."[1] In his attempts to answer *metaphysical* questions about the nature of life and reality, Thoreau turned to a thorough and *scientific*—in the mid-nineteenth century understanding of the term—interrogation of the world based on his experiences. As a careful observer and recorder of both nature and culture, a professional land surveyor, and a dedicated recorder of his observations in his journals and other writings, Thoreau was a "conscientious" experimentalist. He approached his subject (life, reality, nature, the world) as a participant-observer, whose moral convictions and poetic license were assets that authenticated his interpretations and conclusions, not shortcomings that undermined them. Thus it was as a socially engaged man of both science and letters—as a writer, surveyor, scientist and metaphysician —that Thoreau conducted his two year experiment at Walden pond between 1845 and 1847 and reworked his journal recordings until finally publishing them in *Walden* (1854).

As presented in this text, Thoreau's motivation for conducting his experiment at Walden is moral and humanitarian as well as scientific and spiritual. As would any properly-trained experimental scientist of his day, Thoreau begins by identifying a problem: namely, the materialistic values driving New England culture, represented specifically by his neighbors in Concord, to whom he addresses his opening sermon on "Economy." His objective is to "front only the essential facts of life," "to drive life into a corner, and reduce it to its lowest terms" in order to "know [its essence] by experience" and "publish it…to the world."[2] Thoreau hopes to liberate his neighbors from the "shams and delusions" that hem them into "mean lives" of "superfluous and evitable wretchedness," by ferreting out—through deliberate and engaged observation of the physical world—that which is "true," "sublime," and "eternal." Only by attending to the concrete world of "now and here"[3] is truth revealed, reality apprehended, and salvation possible. For Thoreau, solving the problem of capitalist materialism is a scientific and spiritual undertaking that demands a critical and engaged examination of both nature and culture.

Not only does Thoreau imbue natural features such as the pond or trees with symbolic meaning and sacred power, he also renders natural life-processes and mundane practices religiously significant by ritualizing them.

Thoreau's retreat to Walden was not only an *experiment*, however. While Thoreau himself may not have deemed it as such, his Walden project (i.e., his two-year residence at the pond and his literary representation of it) was also a *consecration*. By taking into account the effects of Thoreau's project over the course of the last century and a half, one can see how his project was both a deliberate counter-cultural experiment *and* an effective demarcation of Walden as a sacred site. While the ideas Thoreau formulated during and after his experience have earned him national and worldwide fame, the pond attained new status through his concrete actions. Thoreau's painstaking construction of *Walden*, the text, effectively consecrated its namesake. This consecration yields rich insights for the religion-and-ecology movement, for the ecological implications of demarcating sacred sites through scientific, literary, and religious means remain largely unexplored. Examined together, Thoreau's Walden project and its long-term impact demonstrate how a particular place comes to be recognized as sacred and the implications of this process for the environment. Thoreau's demarcation of Walden as a sacred site shaped not only the way in which subsequent generations have perceived and treated the pond and its surroundings, but also the way it has been physically and figuratively reconstructed over time.

When Thoreau "took his seat" on the shores of Walden pond, he was essentially squatting on a parcel of property that belonged to Emerson. The pond was certainly not the national shrine it has since become. How did Thoreau effect such a transformation? Most obviously, by his literary representation of it as sacred. By describing both the extraordinary purity of the pond and the revelation, restoration and rebirth that he both witnessed and attained there, Thoreau depicts Walden as a spiritually potent "sacred center," to use Mircea Eliade's influential motif.[4] In the central chapter of *Walden*, Thoreau describes the pond as "a perennial spring," a "distiller of celestial dews," and "the earth's eye."[5] As "God's Drop,"[6] Walden is unrivaled in its purity, and its sacred character is emphasized by its eternal, mythic qualities.

> Perhaps on that spring morning when Adam and Eve were driven out of Eden Walden Pond was already in existence.[7]

The book's penultimate chapter, "Spring," emphasizes the sacred qualities of Walden by depicting Thoreau's experience of spiritual and physical rejuvenation. Here Thoreau dramatically describes the natural, yet miraculous, process by which the world is cyclically recreated and innocence is annually restored. Thoreau's literary representation of spring effectively collapses sacred and mundane time such that the cycle of the seasons takes on cosmological significance and Thoreau witnesses and bears testimony to what Eliade might call a hierophany, i.e., a manifestation of the sacred that simultaneously reveals the real, founds a world, and consecrates a particular place in space.[8]

In addition to his literary representations of the pond as a sacred center, Thoreau demarcates Walden as a sacred place when he literally and figuratively maps it in four different ways:

- **scientifically**, by sounding and charting the pond, surveying its surroundings, and observing and recording its natural features and history;
- **narratively**, by representing the pond as a sacred center and describing trees that stand "like temples" and serve as "shrines;"[9]
- **physically**, by marking the site through the construction of edifices (i.e., his hut) and other topographical alterations (such as clearing and cultivating); and
- **ritually**, by commemorating physical features and consecrating mundane objects and activities through mythic and ritual performance. These activities set Walden apart, much as a religious ritual makes a particular time and place sacred.

In the brief scope of this paper, these various means of demarcating Walden as sacred cannot be explored in depth. However, Thoreau's commemoration and consecration of natural or mundane features, objects and activities merits some elaboration. Not only does Thoreau imbue natural features such as the pond or trees with symbolic meaning and sacred power, he also renders natural life-processes (such as eating, drinking, bathing and walking) and mundane practices (such as digging, planting, and hoeing) religiously significant by ritualizing them. Jonathan Z. Smith's definition of ritual as, "first and foremost, a mode of paying attention" and a place-based "process for marking interest" draws attention to the ritualistic elements of Thoreau's Walden experiment, of which sustained, deliberate and place-based attention to the ordinary is arguably the most characteristic feature.[10]

While Thoreau's consecration of Walden Pond, as I am depicting it here, was a deliberate and constructive process of various means of demarcation, it should not be understood simply as an ascription of sacredness to an otherwise ordinary or profane site. By marking, mapping, representing, and ritually attending to Walden Pond and its immediate surroundings, Thoreau drew attention to a particular place as sacred. This does not necessarily mean, however, that the pond and its surrounding woods were not already sacred; it simply means that they were not recognized as such. What his process of consecration shows is that sanctity—or 'value'—is not necessarily *either* inherent *or* ascribed, but might best be understood as a combination of both. Thoreau's "con-scientious" experiment and his consecration of Walden demonstrate not that humans confer sanctity arbitrarily onto mundane places, entities, or activities, but rather that, when these are not adequately attended to with reverence and respect, they are *effectively* desecrated. Thoreau's Walden project illustrates that regardless of whether or to what extent sanctity is natural or cultural, inherent or ascribed, it is clearly the case that inattentiveness to sanctity in the material, natural world is destructive in effect. "Nature has no human inhabitant who appreciates her," he scolded: "Talk of heaven! Ye disgrace earth."[11] It is this recognition that led Thoreau (and subsequent generations of Thoreauvians as well), to associate deforestation with desecration and, by extension, conservation with consecration.

Protecting Walden: The Implications of Consecration

Whether or not Thoreau intended to consecrate Walden, he did so in effect. This is borne out by the way that subsequent generations have perceived and maintained Walden as a sacred site. Of the approximately 600,000 people that currently visit Walden each year,[12] it would be extremely difficult to differentiate between recreationalists, tourists, and pilgrims. Surely, not everyone who visits Walden Pond State Reservation today is a devotee of Thoreau or has even read *Walden*, by now a canonized classic of American literature and virtually a bible for many environmentalists. Nonetheless, all visitors are influenced by and indebted to Thoreau, whether they realize it or not, for without his various demarcations, Walden Pond State Reservation, which consists of 411 acres of protected and accessible open space, would not exist. Instead, the pond and its surrounding woods would be practically unknown and relatively insignificant. As private property, Walden would be familiar to a select few. Moreover, instead of being an integral 'place' or 'site' consisting of both the pond and its surrounding woods, Walden likely would be divided up into parcels, dissected by fences, dotted with houses, cleared, paved, and jealously guarded by signs reading "Keep Out," "Private Property," and "Trespassers will be Prosecuted."

Developments within the American environmentalist movement led to a gradual shift in emphasis from the rhetoric of "preservation" to the more recent model of "stewardship" and ecological "management."

What makes Walden a particularly interesting case study for examining the ecological implications of demarcating specific topographical features or natural places as sacred is the relationship between consecration and conservation that is borne out by the history of Walden's development as a public site.[13] Over the course of the twentieth century, as Walden's status as an important natural, historical, and sacred site grew, so did popular movements to protect it from development and from human-induced alterations. The gradual shift away from the philosophy of preservation, which sought to maintain Walden in its original or pristine form, and toward the philosophy of ecological stewardship, which seeks to maintain a balance between humans and nature, reflects developments within the environmental and conservation movements more generally. Examining this shift highlights not only the dynamic relationship between consecration and conservation, but also the respective ecological consequences of various approaches to protecting and maintaining demarcated sites that are simultaneously natural, cultural, and sacred.

As David Foster demonstrates in *Thoreau's Country*, Walden Pond and its surrounding woods were no more pristine during Thoreau's lifetime than they are today. The history of the development and management of Walden as public and private land since Thoreau's experiment reveals that human interaction with the pond and its surrounding woods have shaped the site both conceptually and physically.

Since the construction of an excursion park at Ice Fort Cove in 1866, Walden has been a popular destination point for recreation-seekers. Although the park burned down in 1902 and was never rebuilt, the pond continued to draw visitors by train and, increasingly, automobile. Beginning in 1922, when the Emerson, Forbes, and Heywood families gave 80 acres of land surrounding the pond to the Commonwealth of Massachusetts, the environmental effects of Thoreau's consecration become increasingly clear. Given to the Commonwealth for the purpose of "preserving the Walden of Emerson and Thoreau, its shores and nearby woodlands for the public who wish to enjoy the pond, the woods and nature," [14] the parcel was then transferred to Middlesex County for oversight and maintenance. The stipulation that "the Walden of Emerson and Thoreau" be preserved in its original or natural condition (despite such radical alterations as the construction of the excursion park) reflects both growing public support for the preservation of places deemed wild or pristine and the increasing popularity of Thoreau's text.

Although the town of Concord has long been a popular tourist destination because of its historical and literary significance, the prominence of Walden as a national "shrine" (as opposed to simply a popular recreation site) increased in the middle of the twentieth century, as important "relics" were discovered and the site became more closely associated with Thoreau and his text, both rapidly attaining status as cultural icons. In 1945, a devotee of Thoreau excavated the remains of Thoreau's hut; two years later, The Thoreau Society, founded in 1941 by Thoreau enthusiasts, commemorated the hut site with a historical plaque that remains to this day. The site has also been marked by "Thoreauvian pilgrims"[15] who perform a ritual of commemoration by placing stones on a large cairn next to the hut's foundation.

The relationship between Thoreau's consecration of Walden, the subsequent history of its preservation, and the related ecological implications is borne out in a legal battle that ensued when concerned members of The Thoreau Society formed the Save Walden Committee in 1957 in order to protest the recent construction of an artificial beach at Walden and to prevent further alterations to the site. The court case between the Middlesex County Commissioners, who aimed to accomodate steadily increasing numbers of visitors to Walden, and the Save Walden Committee, whose supporters equated development with desecration, demonstrates the powerful rhetorical, political, and ecological effects of Thoreau's consecration. The campaign to preserve the "primitive," "unspoiled," "natural," or "original" condition[16] of Walden Pond and its surrounding woods received local, national and global attention, and the public outcries against the desecration of Walden reinforced its designation as a sacred site and elevated its status to, in the estimation of the Thoreau Society, "perhaps the most cherished natural acreage in the world."[17]

The campaign to "save Walden" was deemed a success, and the court case resulted in the Massachusetts Supreme Court ruling on 3 May 1960 against further topographical changes and mandating specific measures aimed at restoring Walden, to the greatest extent possible, to its former condition. Nonetheless, representatives from the Department of the Interior concluded that the original, natural condition of the pond was irrevocably altered by the Middlesex County Commissioners' attempts to render Walden more amenable as a recreation site. This conclusion, along with developments within the American environmentalist movement more generally, led to a gradual shift in emphasis from the rhetoric of "preservation" to the more recent model of "stewardship" and ecological "management."[18]

Campaigns to protect Walden from human alterations to the landscape and from the inevitable impact of hundreds of thousands of visitors per year have reappeared in subsequent decades, and both the reputation of Walden as a historic "shrine" and attempts to preserve or otherwise maintain the site have continued to grow. In 1965, Walden Pond became a Registered National Historic Landmark, and a decade later responsibility for the reservation was transferred from Middlesex County to the Department of Environmental Management, thereby connecting Walden to other protected lands within the Massachusetts State Forests and Parks system.

The most recent of these conservation movements, the Walden Woods Project, aims to expand the acreage of the reserve to include 2,680 acres of woodlands. This goal reflects a shift from the preservationism of the Save Walden Committee to a more ecologically-minded approach that sees the larger Walden ecosystem as essential to the natural and cultural integrity of the pond. Founded by recording artist Don Henley in 1990, the Walden Woods Project is a current manifestation of the relationship between conservation and consecration. Its approach to protecting Walden is especially illuminating because it brings together insights from religion and from contemporary ecological science for the benefit not only of the particular ecosystem of Walden Pond, but for the environment in general. Without romanticizing Walden as pristine, Henley appeals to a theological model of stewardship and argues for the protection of Walden Woods by emphasizing the crucial *symbolic* role of the pond both as "intrinsically valuable" and as "the cradle of the environmental movement."[19] The environmental ethic motivating the Walden Woods Project exemplifies the ecological implications—past, present, and future—of Thoreau's consecration of Walden Pond and, by extension, of demarcating sacred natural sites in general.

The shift in approaches to the protection and maintenance of Walden as a natural *and* cultural shrine over the past century contributes a number of important insights to the relationship between religion and ecology. The rhetoric employed by the Save Walden Committee, which sought to preserve Walden in its original, pristine form, reflects the problematic assumption that both nature and religion are essentially static. The rhetoric of preservation, when applied to a site like Walden, fails to recognize the fundamentally *dynamic* character not only of nature and religion, which are themselves constantly changing processes involving and impacting both humans and the environment, but also and especially of demarcated sacred sites such as Walden, which are quintessentially both natural *and* cultural. When understood as microcosms of a fundamentally dynamic world that is both natural and cultural, sacred and mundane, consecrated natural sites like Walden exemplify the mutually constitutive relationships between religion, science, and the environment and offer new and strategic insights for addressing the various local and global ecological crises that must be faced today.

Works cited:

Buell, Lawrence. *The Environmental Imagination: Thoreau, Nature Writing and the Formation of American Culture.* Cambridge, Mass.: Harvard University Press, 1995.

Cook, Reginald L. "Ancient Rites at Walden." *The Emerson Society Quarterly* 39 (1965): 52-56.

Eliade, Mircea. *The Sacred and the Profane: The Nature of Religion.* Trans., Willard R. Trask. New York: Harcourt, Inc., 1959, 1987.

"Environmental Settings and Current Investigations." USGS Fact Sheet FS-064-98. Washington, D.C.: U.S. Geological Survey, June 1998.

Foster, David R. *Thoreau's Country: Journey Through a Transformed Landscape.* Cambridge, Mass.: Harvard University Press, 1999.

Henley, Don, and Dave Marsh, eds. *Heaven Is Under Our Feet.* New York: Berkley, 1991.

Smith, Jonathan Z. *To Take Place: Toward Theory in Ritual.* Chicago: University of Chicago Press, 1987.

Thoreau, Henry David. *Walden and Resistance to Civil Government*, second edition. Ed., William Rossi. New York: W. W. Norton & Co., 1992.

The Thoreau Society. Letter to members of the Massachusetts General Court (February 19, 1958). Thoreau Institute archives, Concord, Mass.

"Walden Pond State Reservation." Boston: Massachusetts Department of Environmental Management, Division of Forests and Parks, 2000.

"Walden Pond, Massachusetts: Environmental Setting and Current Investigations." USGS Fact Sheet FS-064-98 (June 1998).

Walls, Laura Dassow, ed. *Material Faith: Thoreau on Science.* Boston: Houghton Mifflin, 1999.

Endnotes:

1. Walls, p. xiii. Emphasis in the original.
2. Thoreau. p. 61.
3. Ibid., p. 65.
4. Eliade. passim.
5. Thoreau., pp. 118, 121, 125.
6. Ibid., p. 130.
7. Ibid., p. 121.
8. Eliade, p. 63.
9. Thoreau. p. 135.
10. Smith, p. 103. For further consideration of ritualized action in *Walden*. see Cook.
11. Thoreau.. p. 134.
12. "Walden Pond State Reservation."
13. The following information about the history of Walden Pond as a public site is drawn from various sources, including the "Walden Pond State Reservation" brochure, letters and records of the Thoreau Society and the Save Walden Committee housed at the Thoreau Institute, and legal documents from the court case between residents of Middlesex County and the Middlesex County Commissioners. *Nickols et als. v. Andrew et als.* (Supreme Judicial Court, Suffolk County No. 5924, March 1960); *Moore et als. v Andrew et als.* Supreme Judicial Court. Suffolk County No. 12364, March 1960) and *Nickols et als. v. Andrew et als.* (Middlesex Superior Court No. 20454. October 1958).
14. This phrase from the original deeds is widely reproduced in the records, reports, letters, and legal documents of the Save Walden Committee. See note 13.
15. Buell., ch. 10. "The Thoreauvian Pilgrimage."
16. These descriptors are used frequently in documents of the Save Walden Committee.
17. The Thoreau Society. letter of February 19. 1958.
18. "Walden Pond State Reservation." and "Walden Pond. Massachusetts: Environmental Setting and Current Investigations."
19. Henley, p. 13.

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Climate Change, Flood Risk and Property Value: Assessment of vulnerability and equity in the Boston Metro Area

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The general consensus is that global climate change will result in increased frequency and intensity of extreme weather events. Coastal urban communities are likely to suffer more flood damages as a result of this change, with potential social justice implications regarding how burdens are shared. Current decision-making approaches, mostly based on scientific knowledge and economic efficiency, do not take into account several ethical aspects associated with climate change, including equity concerns. In this paper, the author addresses a number of questions with justice implications. His findings show a differential exposure to hazards and uneven capability to cope with them, which places higher risk on the most vulnerable sectors of the population. The religious community can contribute in raising awareness and helping to explore adaptive measures designed to reduce the economic and social impacts of extreme events in an equitable way.

Introduction

The general consensus is that global climate change will significantly alter a variety of atmospheric and surface conditions. The possible effects of global climate change include sea-level rise and increased frequency of coastal storms and hurricanes. Coastal urban communities are likely to suffer more flooding as a result of this change, unless they become aware of this problem and implement adaptive strategies. On the other hand, population and economic growth in the Boston Metropolitan Area is likely to increase the pressure to develop land, augmenting not only the amount of property at risk but also the runoff that must be handled by rivers, streams, and stormwater systems. This may result in increased flood-related damages.

Policy processes involving mitigation (reduction of greenhouse emissions) and adaptation (adjusting to expected new conditions) tend to be based on the criterion of economic efficiency. This criterion, usually materialized through cost-benefit analysis, is ill-equipped to cope with issues of environmental justice and intergenerational fairness that characterize climate change. It has been argued that those with less capability to adapt will feel climatic change impacts more profoundly.[1] There appears to be consensus on this issue when considering the differences between Northern and Southern countries, for housing condition and location in several developing nations makes them more vulnerable to climate-related risks.[2] Little attention has been paid to this issue in developed countries. The social and moral implications of climatic change can be enormous; and while there is a vast body of scientific knowledge on the issue, science alone cannot guide actions.[3] It is necessary to strengthen the role that ethical values play in decision-making.

My purpose in this paper is to present the faith community with some of the possible implications of climatic change at the local level. Focusing on eight coastal towns located south of Boston, I will attempt to answer the following questions:

- What is the current vulnerability of residential properties to flooding?
- Is there spatial correlation between flood risk and property value?

• What may be the consequences of climate change on the distribution of costs associated with flood damages?

• In what ways can the religious community become involved in these issues?

Following a brief review of the literature regarding climate change and its potential impacts in the Boston area, I will present the study area and the data on flood risk, land use and property values. The next section will provide an overview of the spatial statistics used to analyze that data for assessing vulnerability and equity issues. And finally, I will discuss the findings and present some concluding remarks.

Literature Review

Even though there have been rich discussions about religion and its relation to environmental change,[4] little has been said about the particular role that the religious community can play with regards to global warming and climate change.[5] Awareness about the potential impacts of global climate change is increasing in the scientific realm, as well as in national and international forums.[6] There is a growing body of research addressing the likelihood of changes in precipitation patterns due to global climate change and its impact on water resources. There appears to be consensus that the frequency of extreme events will increase.[7] In particular, intense precipitation events are likely to occur more frequently[8] and, as a consequence, produce more flooding.[9] These perspectives are reinforced by a study based on geological records conducted by J. C. Knox[10] that concluded that both small changes in temperature (1-2 C) and changes in average annual rainfall can result in large changes to flood frequency and magnitude.

Even though the causes for climate change are global in scale, the primary effects will undoubtedly be at regional and local levels. In a study addressing three urban watersheds

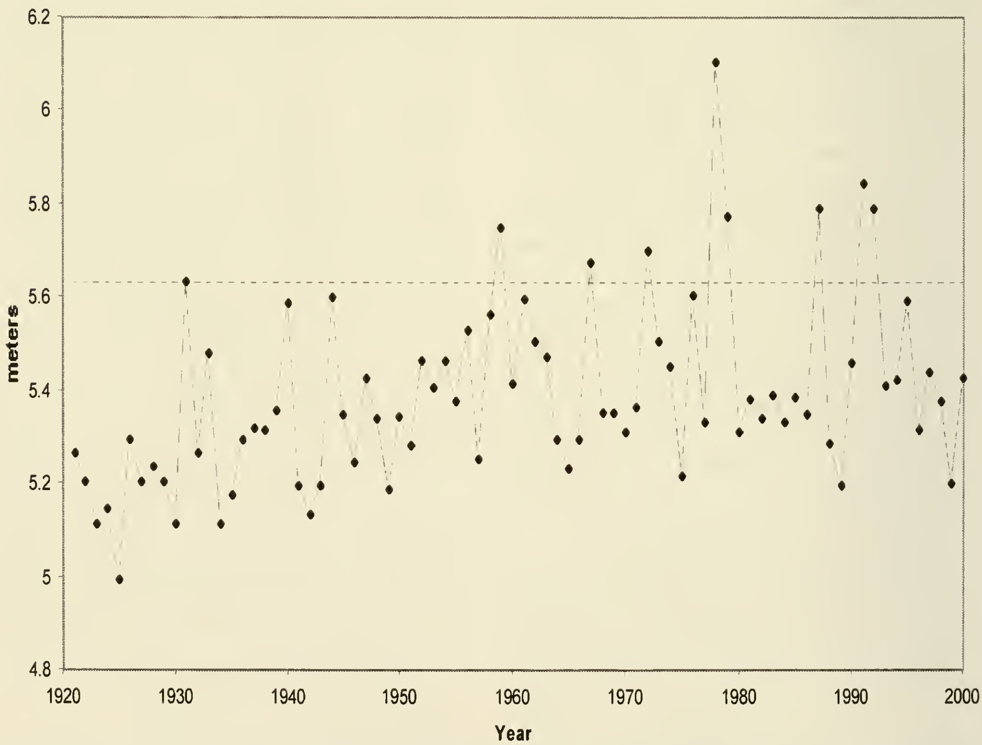

FIGURE 1 - Sea Level at Boston harbor; 1920-2000 (maximum hourly height)

in Australia, Schreider et al.[11] found that a doubling in atmospheric concentrations of CO_2 would lead to significant increases in damage to buildings. In addition to these climatic change effects, economic and population rates of growth are likely to continue the pressure to develop land. These combined factors seem to indicate that there may be more property at risk in flood-prone areas, and that there may be an increased need to manage the additional runoff induced by land-use conversion.

Flood damages in the coast of Massachusetts have been extensively documented.[12] Massachusetts has a very high risk of coastal stormwater and riverine flooding, because of its long coastline, numerous rivers and streams, and concentrated development, in combination with high exposure to heavy rainstorms, hurricanes, and "northeasters." Since 1978, over twenty thousand flood insurance claims have been filed throughout the state, with almost $200-million worth of damage to insured residential and commercial property.[13] This value does not include damages to non-insured structures.

Figure 1 shows the annual maximum sea level measured at Boston Harbor from 1920 to 2000.[14] While sea-level rise appears to be present as a slight trend upwards, the most relevant observation to make is the fact that high-water levels associated with extreme events have increased dramatically over the second half of the period. The effects of a coastal storm such as that of 1978, combined with sea-level rise and increased urban development, could be devastating.

The National Flood Insurance Program (NFIP) is the only provider of flood insurance in the United States. This program requires participating communities to enact certain regulatory standards for new homes built in hazard-prone areas. Only homeowners in participating communities can purchase flood insurance, and the premium is proportional to the structure's vulnerability to damage.

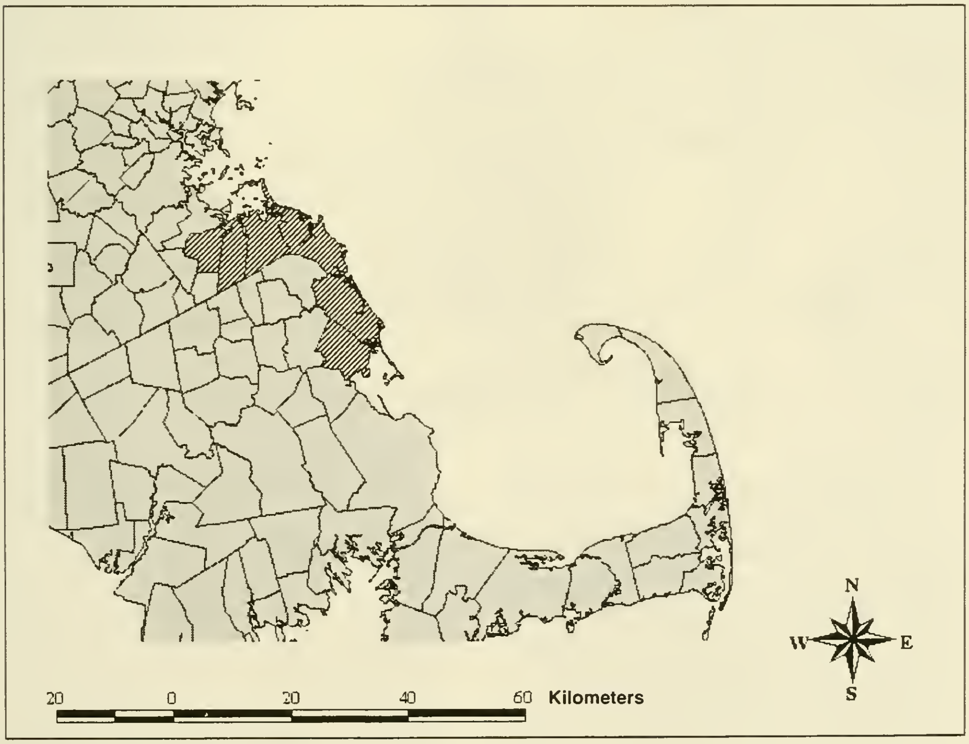

FIGURE 2 - Study Area

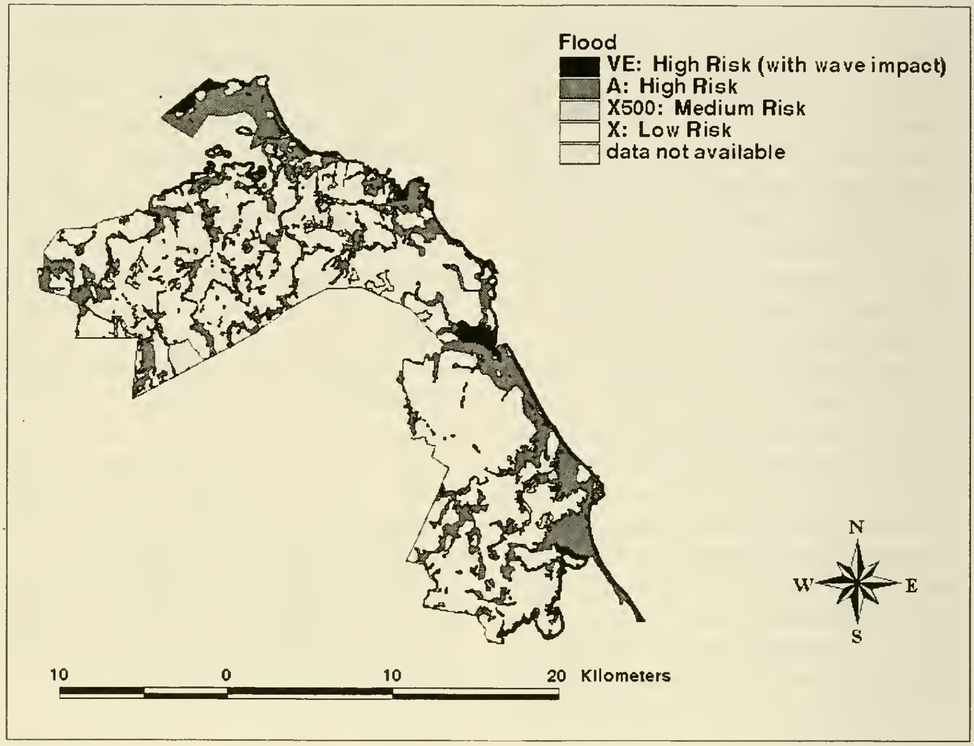

FIGURE 3 - Flood Risk

FTYPE	Risk	Description
VE	High (coastal)	Velocity Zones - Areas with a 1% chance of being flooded at any given year, with wave action hazard
A	High	Areas with a 1% chance of being flooded at any given year (100-year floodplain)
X500	Medium	Areas with a 0.2 % chance of being flooded at any given year (500-year floodplain)
X	Low	Areas with less than a 0.2% chance of being flooded at any given year.
N/A	Not Available	Areas not mapped by FEMA.

NFIP does not keep data on the proportion of insured homes at each location. According to personal communication with FEMA-Region I officials, the coverage rate is approximately 95% in areas subject to coastal storm damage with wave action, and about 50% in other areas. Given the preventive nature of these expenditures, homeowners with relatively low income are less likely to acquire insurance and, therefore, may be less able to recover from the damages inflicted by extreme events.

There is abundant evidence on the convenience of addressing flood hazards through land-use planning and Best Management Practices.[15] Given the host of uncertainties associated with climate change, some policy analysts recommend that decision-makers identify short-term strategies in the face of long-term uncertainty.[16] Unfortunately, adaptation to global climate change is not yet in the local policy agenda. This may be caused, in part, by the lack of dialogue between local officials and the climate change research and policy forums. Geographic Information Systems (GIS) can help people understand the communal risks and define adaptive options. This understanding can help them to embrace, through floodplain management, the call to think globally and act locally.

Study Area and Overview of Data

The study area comprises eight coastal towns located south of Boston, Massachusetts: Braintree, Cohasset, Duxbury, Hingham, Hull, Marshfield, Scituate, and Weymouth (Figure 2). These communities are relevant to the research questions addressed by this paper because of two main reasons: (1) By virtue of their location, topography, hydrology, and urbanization patterns, these towns are subject to different types of flooding risks. Their coastal nature makes them particularly susceptible to potential impacts associated with climate change, including sea-level rise, increased storminess, and more frequent hurricane events. (2) As suburbs of the Boston Metro Area, they present a rich variety of land uses, and include residential areas of diverse densities. Given the sprawling trends of American

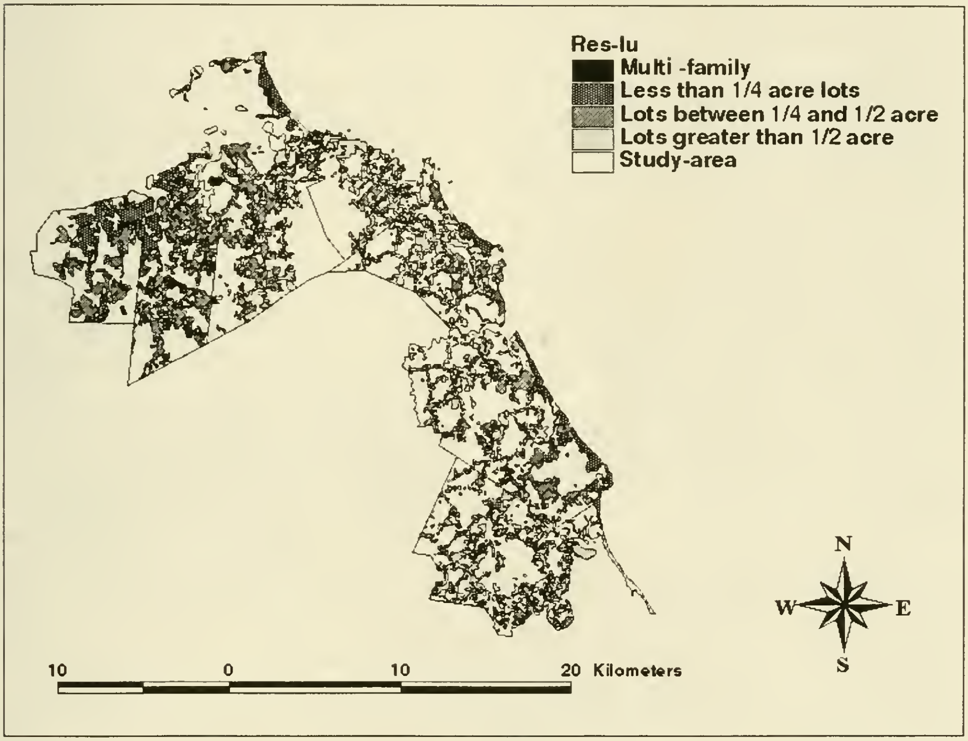

FIGURE 4 - Residential Density

CODE LU21	Residential Density [units per acre]	Description
10	8	Multi-family
11	5	Smaller than 1/4 acre lots
12	2.66	1/4 to 1/2 acre lots
13	1.33	Larger than 1/2 acre lots
others	0	Non-residential land use

metropolitan areas in general, and of Boston in particular, these communities are experiencing pressures for increased land-use conversion, which may affect future flood risk in this area.

In order to explore vulnerability and equity issues in this study area, three different types of geographically referenced data are used: flood risk, land use and property value. The spatial distribution of these features will constitute the basis of the statistical analysis performed in the following section. n essence, the purpose of that analysis is to determine how many housing units are subject to flooding, and whether homes with different property values tend to be located in areas prone to different levels of flood risk.

• **Flood Risk:** Based on hydrological studies, the Federal Emergency Management Agency prepares Flood Insurance Rate Maps (FIRMs) that depict the spatial extent of flood hazard areas and other thematic features related to flood risk assessment. This information is available in digital format through Q3 Flood Data coverages by quadrant. FEMA defines twenty different categories of flood hazard zones, according to risk and amount of information available.

For the purposes of this study, the twenty different flood risk classifications provided by FEMA have been grouped into four categories (See Figure 3).

• **Land Use:** The MassGIS statewide land use datalayer has land use classifications by town, interpreted from aerial photography. There are four different residential land uses coded in the coverages, according to density. In order to estimate the number of housing units per unit area, the densities were assumed as shown in Figure 4.

• **Property Value:** The U.S. Census Bureau provides information on the amount of housing units contained in each Census Block Group, according to twenty different property value categories (from less than $25,000 to over $500,000.) According to the data for the base year (1990), the study area contains a total of 302,074 housing units.

Property values are not homogeneously distributed. For any given portion of the study area, we are interested in the average property values of its housing units relative to that of the entire study area. For this purpose, a Relative Property Value Indicator (RPVI) was estimated for each census block group, according to the following formula:

$$RPVI_i = \frac{MeanVal_i}{MeanVal_{SA}} \times 100\% ,$$

where $MeanVal_i$ is the average property value of polygon i, and $MeanVal_{SA}$ is the average property value of the study area. Both numerator and denominator were estimated using the weighted average:

$$MeanVal_i = \frac{\sum_{j=1}^{20} \lambda_j \times X_j}{\sum_{j=1}^{20} X_j}$$

where X_j is the number of housing units within property-value range j, and λ_j is the average property value within that range, for area i.

Using this Relative Property Value Indicator, each census block was assigned a Relative Housing Value (H-Val) as shown in Figure 5.

Spatial Analysis for Assessing Vulnerability and Equity

The object of this section is to determine the total number of housing units that are subject to flooding, and whether there is spatial correlation between flood risk and housing value. This can be accomplished by constructing a contingency table of the total number of housing units located in residential areas with different combinations of flood risk and relative housing value. The coverages being used at this stage contain information about flood risk relative housing value, and housing.

The three coverages were intersected. The number of housing units in each resulting polygon was determined based on housing density using the following formula:

$$HH_i = k_u k_c \gamma_i \mathbf{A}_i ,$$

where HH_i is the number of housing units in polygon i, γ_i is the housing density of polygon

Coverage	Information	Item	Values
Flood	Flood Risk	Ftype	*VE* (High risk, coastal), *A* (High risk), *X500* (Medium risk), *X* (Low risk), N/A
H-Val	Relative Housing Value	H-Val	Low, Medium, High, Very High
Res-lu	Housing Density	dens-res	0; 1.33; 2.66; 5; 8 [units per acre]

i in housing units per acre, $\mathbf{A}_i$ is the area of polygon *i* in square meters, k_u is the unit conversion factor, and k_c is a correction factor that that accounts for the difference between the total number of housing units observed in the census and that estimated by multiplying density times area.

The statistics capabilities of GIS simplify the construction of the contingency tables for frequency of housing units in residential areas per flood risk and relative property value (see Table 1: Observed Frequencies).

From Table 1 we can see that the study area is significantly vulnerable to flooding events. Almost 35,000 dwellings (11.3 % of the total) are located in flood-prone areas ("*A*" or "*VE*" flood risk). Of these, over four thousand housing units are in what FEMA calls *velocity zones* (areas where wave impact can inflict serious damage to structures.) Climate change is likely to increase the probability of extreme events hitting the region, with potentially devastating effects on these residential areas.

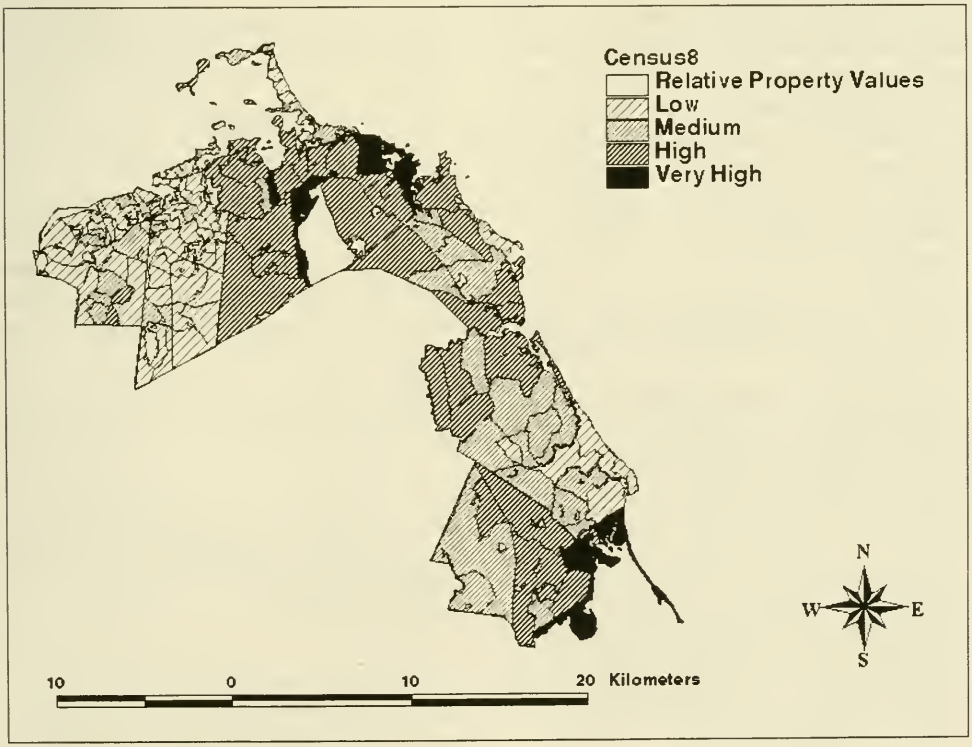

FIGURE 5 - Relative Property Value

RPVI (%)	Less than 90%	90% to 120%	120% to 170%	Over 170 %	
H-Val **Flood Risk**	**Low**	**Medium**	**High**	**Very High**	**Total**
VE (High, coastal)	1502	730	1391	441	**4063**
A (High)	17064	3727	7229	2169	**30190**
X500 (Med)	2040	604	310	86	**3040**
X (Low)	108237	69815	74285	12444	**264781**
Total	**128843**	**74876**	**83216**	**15139**	**302074**

Table 1: Observed Frequencies (actual number of dwellings by flood risk and relative property value)

The rest of this section will present the spatial statistics used to evaluate the equity aspects of flood vulnerability in the study area. One approach to the equity issue is to evaluate whether there is spatial correlation between flood risk and property values in the eight towns that comprise the study area. An equitable situation would imply that flood risk is not significantly related to property values. In other words, a socially just situation would entail that the probability of being located in a flood-prone location is not dependent on how expensive a dwelling is.

In order to evaluate whether that is the case, I will use spatial statistics to test the following null hypothesis: "Relative Housing Value is not contingent on Flood Risk."

$$H_0: P[(Ftype=Ftype_0) \text{ and } (H\text{-}Val = H\text{-}Val_0)] = P(Ftype=Ftype_0) \times P(H\text{-}Val = H\text{-}Val_0)$$

A contingency table analysis will be used to accept or reject this null hypothesis. In essence, the purpose of this test is to compare the existing spatial distribution of risk with a hypothetical distribution that assumes homogeneity. If the study area presented a homogeneous distribution of relative property values for each type of flood risk, then the expected frequency for any combination of Ftype and H-Val would be given by the formula:

$$E_{ij} = \frac{Sum_i \times Sum_j}{N}$$

E_{ij} is expected frequency of housing units with Ftype = i and H-Val = j. Sum_i is the total count of housing units with Ftype = i, and Sum_j is the total count of housing units with Ftype = j, and N is the total number of housing units in the study area. Table 2, below, shows the expected frequencies

We can now proceed to estimate the test statistic T, which is based on the deviations between observed and expected frequencies and responds to a chi-square distribution.

$$T = \sum \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$$

O_{ij} is the observed frequency (from Table 1), and E_{ij} is the expected frequency (from Table 2) of housing units with Ftype = i and H-Val = j.

We obtain a value of $T = 5476$. The critical value of chi-square for 3x3 degrees of freedom and 95% confidence is 16.91, which is much smaller than the one obtained from the data. Therefore, I can reject the null hypothesis. This implies that there is a very strong spatial association between flood risk and relative property value.

- $T >> T_{critical}$; therefore, the null hypothesis can be rejected. There is spatial correlation between flood risk and relative house values.

H-Val Flood Risk	Low	Medium	High	Very High
VE (High, coastal)	1733	1007	1119	204
A (High)	12877	7483	8317	1513
X500 (Med)	1297	754	838	152
X (Low)	112936	65632	72942	13270
Total	**128843**	**74876**	**83216**	**15139**

Table 2: Expected Frequencies (hypothetical number of dwellings under homogeneous distribution)

In order to understand how this association works, I construct a table with deviations between observed and expected values, expressed relative to expected values (Table 3). A homogeneous distribution would imply that for all possible combinations of flood risk and Relative Property Value (H-Val), there would be no difference between the observed value O_{ij} and the expected value E_{ij} and therefore the deviation $(O_{ij} - E_{ij})/ E_{ij}$ should be zero. A deviation larger than zero indicates that the frequency of households is relatively high.

The largest deviations, shown in Table 3, occur when H-Val is either 'Very High' or 'Low'. Figure 6 shows graphically how these deviations vary by Flood Risk and by Relative Property Value. It can be seen that areas with *VE* Flood Risk have a high frequency of very expensive homes; zones with flood risk equal to *A* present a larger proportion of both the cheap and the expensive ends of the spectrum. Finally, areas with flood risk equal to *X500* present a high frequency of cheaper homes.

Conclusions

The eight towns that comprise the study area are highly vulnerable to flooding, with over eleven percent of the housing units located in flood-prone areas. The likelihood of finding expensive homes in *VE* flood risk zones (areas of high risk with wave impact) is very high. This is consistent with the fact that *VE* zones are located on the coast, which provides a beautiful landscape and usually increases the price of land (we can expect to find more expensive homes on expensive land.)

Since the rate of flood insurance coverage in velocity zones is about 95%, these homeowners are better prepared to absorb the costs of extreme events. On the other hand, in *A* and *X500* zones (medium to high flood risk) the average coverage rate is about 50%. Given that in these zones the relative home value is significantly lower than average, we can conclude that homeowners of relatively cheaper homes are less capable of dealing with the economic impact of extreme events.

Regulations affecting the construction of new homes, as well as future trends in land use conversion, may exacerbate this disparity: on one hand, existing regulations demand more safety provisions in new homes built in areas exposed to coastal hazards. On the other, urban growth trends increase the imperviousness of watersheds, therefore augmenting the risk of riverine flooding in residential areas that currently show relatively lower property values. This differential exposure to risk (and of homeowners' capabilities to cope with it) can have enormous implications if climate change were to augment the frequency of extreme events.

The effects of climatic change can vastly exacerbate inequalities. The uncertainties associated with potential consequences of a changing global climate seriously challenges the role that scientific knowledge and ethical values play in decision-making. Issues of economic efficiency may be insufficient to trig-

H-Val Flood Risk	Low	Medium	High	Very High
VE (High, coastal)	-0.13	-0.27	0.24	1.16
A (High)	0.32	-0.50	-0.13	0.43
X500 (Med)	0.53	-0.20	-0.63	-0.43
X (Low)	-0.04	0.06	-0.02	-0.06

Table 3: Deviations $(O_{ij} - E_{ij}) / E_{ij}$

ger the actions needed to adequately mitigate and adapt to global climate change. These actions may involve changes at different scales, from individual patterns of consumption to municipal approaches to zoning and floodplain management to national policies and international negotiations on carbon emissions or financial aid to victims of natural disasters. Change is most effective when it is promoted at all scales, from local to global, and when it is encouraged from firm ethical positions.

Several commentators have reached the conclusion that climate change demands a change in values, not just in knowledge.[17] The faith and science community can strengthen the links between our values and our changing global environment. Religious institutions can contribute in raising awareness about and helping to explore adaptive measures designed to reduce the economic and social impacts of extreme events in an equitable way.

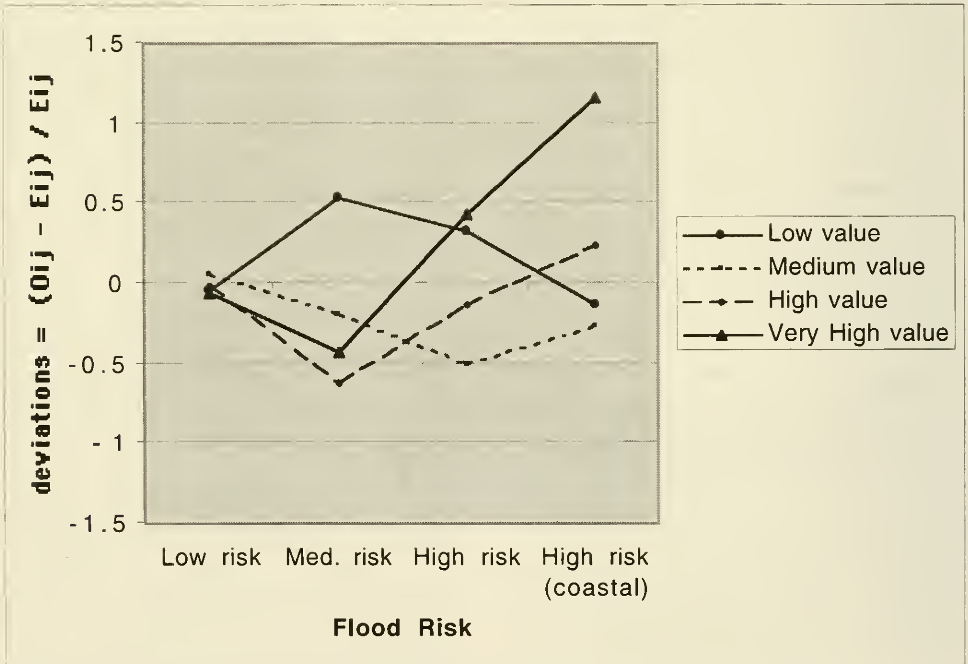

FIGURE 6 - Deviations vs Flood Risk (by Relative Property Value

Works cited:

Attfield, Robin. *The Ethics of the Global Environment.* West Lafayette, Ind.: Purdue University Press, 1998.

Conroy, Donald, and Rodney Petersen, eds. *Earth at Risk: An Environmental Dialogue Between Religion and Science.* Amherst, Mass.: Humanity Books, 2000.

Coward, Harold G., and Thomas Hurka, eds. *The Greenhouse Effect: Ethics and Climate Change.* Waterloo, Ont.: Wilfrid Laurier University Press, 1993.

Federal Emergency Management Agency, *Interagency Hazard Mitigation Team Report Covering the Counties of Essex, Middlesex, Norfolk, Plymouth and Suffolk.* Boston: Federal Emergency Management Agency, 1997.

Fowler, A. M., and K. J. Hennessy. "Potential Impacts of Global Warming on the Frequency and Magnitude of Heavy Precipitation." *Natural Hazards* 11 (1995): 283-303.

Howarth, R. B., and Monahan, P. A. "Economics, ethics, and climate policy: Framing the debate." *Global and Planetary Change* 11 (1996): 187-99.

Grubb, M. "Seeking Fair Weather: Ethics and the International Debate on Climate Change." *International Affairs* 71 (1995): 463-96.

Intergovernmental Panel on Climate Change (IPCC). *Technologies, Policies and Measures for Mitigating Climate Change.* Geneva, Switzerland: Intergovernmental Panel on Climate Change, 1996.

_____. *The Regional Impacts of Climate Change: An Assessment of Vulnerability.* Cambridge: Cambridge University Press, 1998.

Jamieson, D. "Ethics, Public Policy and Climate Change." *Science, Technology and Human Values* 17 (1992): 139-53.

Katz, R. W., and B. G. Brown. "Extreme Events in a Changing Climate." *Climatic Change* 21 (1992): 289-302.

Knox, J. C. "Large Increases in Flood Magnitude in Response to Modest Changes in Climate." *Nature* 361 (1993): 430-32.

Leavesley, G. H. "Modeling the Effects of Climate Change on Water Resources: A Review." *Climatic Change* 28 (1994): 159-77.

Massachusetts Emergency Management Agency. *Massachusetts Hazard Mitigation Plan.* Boston: Massachusetts Emergency Management Agency, 2000.

National Oceanographic and Atmospheric Agency (NOAA)/National Ocean Services (NOS). "Observed Water Levels and Associated Ancillary Data." Internet document (2001). <http://www.co-ops.nos.noaa.gov/data_res.html> (2001).

Rayner, Steve, and Elizabeth Malone, eds. *Human Choice and Climate Change.* Columbus, Ohio: Battelle Press, 1998.

Rosen, Howard, and Martin Reuss. *The Flood Control Challenge: Past, Present and Future.* Chicago: Public Works Historical Society, 1988.

Rothman, D. S. "Measuring Environmental Values and Environmental Impacts: Going from the Local to the Global." *Climatic Change* 44 (2000): 351-76.

Saul, Adrian J. *Floods and Flood Management.* London: Kluwer, 1992.

Schoenfeld Associates, Inc. *A Report on the Assessment of Flood Damages resulting from the Storm of 6-7 February 1978 along the Coastline from Orleans, Massachusetts to New Castle, New Hampshire.* Boston: United States Army Corps of Engineers, 1978.

Schreider, S. Y., D. I. Smith, and A. J. Jakeman. "Climate Change Impacts on Urban Flooding." *Climatic Change* 47: (2000) 91-115.

Stoll-Kleemann, S., T. O'Riordan, and C. C. Jaeger. "The Psychology of Denial Concerning Climate Mitigation Measures: Evidence from Swiss Focus Groups." *Global Environmental Change—Human and Policy Dimensions* 11 (2001): 107-17.

United States Army Corps of Engineers. *Massachusetts Coastal Study.* Boston: United States Army Corps of Engineers, 1978.

United States Department of Housing and Urban Development. *Evaluation of the Economic, Social and Environmental Effects of Floodplain Regulations.* Washington, D.C.: Department of Housing and Urban Development, 1981.

United States Geological Survey. *Coastal Flood of February 7, 1978, in Maine, Massachusetts and New Hampshire.* Boston: United States Geological Survey, 1979.

Wagner, D. "Assessment of the Probability of Extreme Weather Events and Their Potential Effects in Large Conurbations." *Atmospheric Environment* 33 (1999): 4151-55.

Weijers, E. P., and Pier Velinga. *Climate Change and River Fooding: Changes in Rainfall Processes and Flooding Regimes Due to an Enhanced Greenhouse Effect.* Amsterdam: IVM, Vrije Universiteit, 1995.

World Council of Churches. *Overview of the World Council of Churches' Programme on Climate Change.* Geneva, Switzerland: World Council of Churches, Programme Unit III—Justice, Peace and Creation, 1995.

Endnotes:

1. Rayner and Malone.

2. Intergovernmental Panel on Climate Change, *The Regional Impacts of Climate Change.*

3. See Rothman; Howarth and Monahan.

4. Conroy and Petersen.

5. See World Council of Churches.

6. Intergovernmental Panel on Climate Change (IPCC).

7. Katz and Brown; Leavesley; and Wagner.

8. Fowler and Hennessy.

9. Weijers and Velinga.

10. Knox.

11. Schreider, Smith, and Jakeman.

12. See the following: Schoenfeld Associates, Inc.; United States Army Corps of Engineers; United States Geological Survey; Federal Emergency Management Agency.

13. Massachusetts Emergency Management Agency.

14. Atmospheric Agency (NOAA)/National Ocean Services (NOS). Graph based on data available at the website.

15. U.S. Department of Housing and Urban Development; Rosen and Reuss; and Saul.

16. Intergovernmental Panel on Climate Change, *Technologies, Policies and Measures.*

17. See Grubb; Jamieson; Stoll-Kleemann, O'Riordan, and Jaeger; Coward and Hurka; and Attfield.

Pablo Suarez obtained a degree in civil and hydraulic engineering at Universidad Nacional de La Plata, Argentina. After working for over two years in his home country, he came to the US to pursue a masters in Community Planning and Development. He was a research affiliate at MIT's Center for Environmental Initiatives and has worked for the United Nations environment Programme (UNEP) and the American Association for the Advancement of Science (AAAS). Pablo is currently a Ph.D. candidate in the Department of Geography at Boston University and he is also president of BU Student Pugwash, a student organization that promotes the socially responsible use of knowledge.

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How Critical is Realism?

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The author explores the role of critical realism as the dominant epistemology in the science-and-religion dialogue. He presents the historical and philosophical peculiarities of this approach that have lead to its preeminence. Asking whether "science and religion" would benefit from greater epistemological variety, he presents a possible alternative to critical realism: enactionism, as articulated by Francisco Varela, Evan Thompson, and Eleanor Rosch in their book The Embodied Mind. *Enactionism is not proposed as the replacement for critical realism, but the author wonders how science and religion would look given an enactionist epistemology.*

In 1966 Ian Barbour published *Issues in Science and Religion.* This text inaugurated the contemporary dialogue between religion and science. In its second section, "Religion and the Theories of Science," Barbour compares and contrasts the methodologies of science and theology. He concludes that there are both significant similarities and differences between the ways these two realms of inquiry operate. Some of the differences arise because the two modes of inquiry ask distinctive types of questions about distinctive types of experience. The distinctiveness of experience reflects the underlying fact that science and religion deal with dissimilar aspects of reality.[1] Yet despite this incongruence, Barbour is committed to the idea of a "wider search for coherence and synthesis which leads to a concern for metaphysics." [2] This wider search is aided by Barbour's epistemology: he identifies himself as a critical realist. What this epistemological perspective entails for the science and religion dialogue is the topic of this paper.

Barbour's advocacy of a critical realist epistemology has had far-reaching implications. Critical realism has become the dominant epistemology in the dialogue between science and religion.[3] Why is this the case? From a sociological perspective, it could be argued that the dominance of critical realism has to do with the status of its advocates within the overall science-and-religion dialogue. Barbour, the "grandfather" of the modern dialogue, strongly espouses it. So too do Arthur Peacocke and John Polkinghorne, two other foundational figures.[4] The writings of all three of these thinkers form a central portion of an emerging "canon" in the science-and-religion field, thanks in large part to the Science and Religion Course Program. This program, which seeks to promote the teaching of courses in science and religion by offering $10,000 grants to faculty who teach them, includes these authors in its "Brief Bibliography in Science and Religion," as well as in the bibliographies of many of its "model" courses.

While a sociological analysis of the dominance of critical realism along these lines could be fruitful, here the focus will be on the philosophical sources of critical realism's success. Critical realism apparently offers scholars in science and religion something that other epistemologies do not. What is this? What is it about critical realism that makes it seem the obvious, or best, choice for so many people working at the interface of science and religion? And what might this dialogue look like if a different epistemology were employed?

To understand the appeal of critical realism as an epistemology, it is necessary to make explicit what is implicit—an underlying commitment to ontological realism. The entities postulated by theologies and scientific theories are not merely instrumental constructs. They are *intended* to be interpreted as actually existing in the world (or beyond it, in the case of some theologies). Of course, it is important to qualify this claim, particularly for science. The entities proposed by science have a dual nature. They are, on the one hand, intended to refer to real entities. At the same time, however, their ontological status is acknowledged to be provisional until such time as their existence is confirmed by experiment.[5] When, exactly, the existence of theoretical entities is sufficiently confirmed to grant them "actual" existence is a debated issue. For the current discussion, however, the significant point is the *intention*. Scientific realists do not propose entities merely for instrumental purposes. It is assumed that these entities are being proposed because entities "something like them" actually exist in the world.

The case of theology is in some ways more complicated than science, because theology, by and large, is not in the business of proposing the existence of entities. To be sure, theology does speak of entities, but the most important of these, God, is not *proposed* by theology. Rather, the existence of God is an assumption of theology. Many theologians are concerned with explicating the relationship of God and humans or God and the cosmos—or trying to understand the nature of the divine being itself. This last, in particular, makes theological realism somewhat different from scientific realism. Because of the radical difference between God and creation—God is infinite while creation is finite—Thomas Aquinas, following Maimonides, asserted that any attribute proposed of God, while meaningful, is unlike that same attribute applied to ourselves. So, while one may speak of God as love, this love is unlike the love that can be experienced. This creates problems for a realist interpretation of theology. How can any theological reflections on God be understood to have a referent, if God's infinity makes God wholly unlike the things postulated of God?

This epistemological conundrum opens the door for critical realism. Theologically, one may not wish to refute in its entirety Thomas's claim about the discontinuity between God and the world. To do so would make God a being like beings in the world and create problems for understanding God as creator and the world as creation. However, by adopting a critical realist stance, it may be possible to maintain the transcendence of God, while at the same time allowing that some knowledge of the divine can be gained. How is this accomplished?

Critical realism asserts that all knowledge is inherently partial and incomplete. As opposed to naïve realism, which says that one directly confronts the "objective" world in one's perceptions, critical realism views knowledge of the world as mediated. This mediation has a variety of sources. One's perspective is limited, due to the constraints imposed by one's locatedness in the world, and by the physical structure of the senses (and by extension, the structure of sense-extending technologies). Perhaps more significant is the claim that all knowledge, scientific and theological alike, is symbolic. Overlooking this symbolic nature leads to literalism in both fields.[6] The importance of this recognition of the symbolic nature of thought is that since symbols are abstractions, they cannot represent *all* the features of their referent. Thus, in symbolic thought some aspects of the referent are always neglected.[7] Knowledge of the world is inherently partial, due to constraints of the thought process. These constraints (viz., of locatedness, of our physical senses, and of our symbolic thought) account for critical realism's claim that all knowledge is partial, but it remains to be shown how this claim of the inherent incompleteness of knowledge helps overcome the problem of reference in theological language about God.

While the attributes one predicates of God cannot be taken literally, symbolic language allows the construction of metaphors. In metaphors, knowledge is applied from an area of familiarity to a novel or unknown area.[8] When one speaks of God as love, this is a metaphor. *Human* experience to understand the divine being. Is this simply poetic language? George Lakoff and Mark Johnson argue that it is not: metaphors are not just poetic or rhetorical: rather, they are found in all modes of human knowledge. Significantly, metaphors figure prominently in scientific discovery.[9] What is the status of knowledge acquired from metaphorical thought? As Janet Soskice asks:

> [H]ow can we claim that these metaphorical terms are in some sense descriptive, or as I prefer to say, reality depicting, prior to and without definitive knowledge of reality?[10]

Soskice is a critical realist, and in order to answer this question from a realist perspective she turns to theories of reference. In particular, she relies on the work of Saul Kripke and Hilary Putnam. The essence of their theories, according to Soskice, is that "reference depends, in normal speech, as much on context as on content and that reference is an utterance-dependent notion." [11] She then cites the work of Richard Boyd to make the transition from metaphor in normal speech to metaphor in science.[12]

Neither science nor religion, on a critical realist interpretation, can provide complete knowledge of the world, because each is a limited enterprise—limited by both its methods and its specific symbol system. For those interested in establishing a fruitful dialogue between science and religion, this has obvious benefits.

Through her use of theories of reference, Soskice tries to establish that metaphors can have a positive cognitive content despite the unknown nature of the entities they are used to describe. Following Kripke, she concludes that this provides for a realist interpretation of metaphorical theoretical terms.[13] Descriptions of the theoretical entities may be completely mistaken, but the context in which they are proposed still allows the claim that what they are *intended* to refer to is a real thing. With such an epistemology in place, metaphorical explications of the divine nature can be understood to have real referents even if those explications can never be entirely adequate.

In so far as critical realism recognizes that knowledge of the world is inherently limited, it is an extremely useful epistemology for the science-and-religion dialogue. This utility owes much to the epistemic humility it calls for in both science and theology. Neither science nor religion, on a critical realist interpretation, can provide complete knowledge of the world, because each is a limited enterprise—limited by both its methods and its specific symbol system. For those interested in establishing a fruitful dialogue between science and religion, this has obvious benefits. Since neither field can legitimately claim to be the only path to complete knowledge of the world, a strong polarization of the sides is subverted.

Critical realism also entails a further claim that makes it appealing to those interested in questions at the interface of science and religion. According to Barbour, realists in general (and critical realists in particular) deny the premise that the real is limited to the observable.[14] In place of observability, Barbour proposes intelligibility as the hallmark of reality.[15] This greatly expands the realm of the real, making it much more accommodating to the kinds of non-observable entities dealt with in theology. As long as the theories of theology meet acceptable standards of evaluation, standards that share criteria with those proposed for the evaluation of scientific theories (e.g., fruitfulness, coherence, simplicity, explanatory power), they can be taken to be reality-depicting, according to Barbour's criteria of intelligibility. This is not simply a clever way of allowing theology to claim that its language about God has an actual referent. The same move from observability to intelligibility is applied in the realm of science to argue for the existence of theoretical entities that are non-observable both in practice and in principle. Critical realism opens the door for dialogue between science and religion by preventing either side from monopolizing knowledge-claims, and by extending the realm of the real in a way that is conducive to theology. This facilitation of dialogue is, I believe, the primary reason why this epistemology has taken on a central role in the science-and-religion dialogue.

The acceptance of critical realism has also been based on contextual factors. The science and "religion" dialogue has been accused of being a misnomer; the dialogue is not between science and religion, but primarily between science (and particular sciences, at that) and Christianity. While this is changing—the Science and Religion Course Program, for example, is explicitly trying to establish a dialogue in Islamic Africa and the Middle East—there have also been attempts to justify this bias. Peacocke argues that the bias towards Christianity results from the historical fact that modern science emerged in a predominantly Christian environment. This historical circumstance, combined with the claims to epistemic authority made by both science and Christianity, have resulted, at times, in clashes between science and Christianity—hence the need for a dialogue.[16] The emphasis on Christianity has had broader repercussions than simply limiting the dialogue to the perspectives of one religion (diverse as Christianity is): it has also limited the dialogue to Western philosophical perspectives. This is important, as critical realism relies heavily on certain assumptions of Western philosophy.

Critical realism proposes that there is a world "out there": a world separate from and, for the most part, independent of the observer. Realist ontology accords with the intuitive sense of the way the world is—there are "things" in the world. Realist epistemology then argues that knowledge of the world is knowledge of these "things." Underlying both this ontology and epistemology is a distinction, a separation, between knower and known. The knower is removed from the world that is known. This subject-object dualism has led to all manner of difficulties for Western philosophy. In particular, if knowers are separate from the world, how can reliable knowledge of the world be gained? This subject-object dualism is Descartes's legacy to Western philosophy, and critical realism is but one in a long line of attempts to answer this question.[17]

Critical realism opens the door for dialogue between science and religion by preventing either side from monopolizing knowledge-claims, and by extending the realm of the real in a way that is conducive to theology. This facilitation of dialogue is, I believe, the primary reason why this epistemology has taken on a central role in the science-and-religion dialogue.

Critical realism rests on the idea that objects of the external world are represented in the mind symbolically. These symbols, though inherently limited in their ability to depict "reality," nonetheless fairly accurately represent the world.[18] This kind of mental representation emerges from a cognitivist, or computationalist, philosophy of mind, in which the mind is essentially a symbol-processor/manipulator.[19] Because the mind is limited to information-processing tasks, it can be analyzed and discussed independently of its particular physical manifestation and the world in which it finds itself.[20] Thus, Descartes's separation of mind and body remains alive and well in critical realism.

While critical realism accepts the cognitivist account of the mind, cognitivism has been challenged within cognitive science. Alternative theories of the mind have been proposed that attempt to do away with Cartesian dualism—some more radically than others.[21] If cognitive science has questioned the validity of a mind separated from the physical world, why has religion-and-science, via critical realism, remained content with cognitivism? For one thing, it fits neatly into a Christian framework: the idea of a mind that is more or less independent of the specifics of the physical world accords easily with traditional Christian notions of the soul. For another, the cognitivist view of the mind does not challenge the idea of an objective, mind-independent world, often associated with science.

The consonance between cognitivism and ideas of the soul evidences the primacy of Christianity in much of science and religion. If the science-and-religion dialogue were dominated by a different religious tradition, specifically one that does not have a notion of the soul, would critical realism have been as likely to become the basic epistemology? It seems reasonable to speculate that a worldview that does not see the person as having an immaterial "essence" would not frame epistemological questions in terms of the problem of knowing an external, independent world. A worldview that does not posit the knower as independent of the world would likely not fixate on Descartes's and Locke's question—how can immaterial minds have knowledge of the material world? Without the split between mind and body, subject and object, a realist ontology that posits a world "out there" would not seem intuitively obvious.

The dominance of critical realism in the science-and-religion dialogue, like the dominance of Christianity, has a great deal to do with the historical and cultural context in which the dialogue has, for the most part, taken place. This raises a number of questions. The overarching question is this: Is critical realism the most productive epistemology for this dialogue? This complex question needs to be broken down in order even to begin to answer it. A few starting questions might be: How is "productivity" to be assessed? What are the boundaries of the dialogue? If it is predominantly Christian, the answers will be very different than if the dialogue is explicitly inter-religious. What are the goals of the dialogue? How these goals are established relates both to the boundaries of the dialogue and to the issue of how productivity is assessed.

Proponents of critical realism could argue that its predominance is itself evidence of its productivity. If a better theory existed, surely it would be the one everyone uses. They could also claim that within a Christian context critical realism is the best choice. If they are to be self-reflexive, however, they must acknowledge that this judgment is predicated upon certain philosophical commitments, the most significant among which, I believe, is the independence between mind and world. If this commitment were set aside, would other epistemologies become at least as productive, if not more so, for the dialogue?

Francisco Varela, Evan Thompson, and Eleanor Rosch have constructed an alternative to critical realism's view of the mind. Their alternative, called enactionism, is proposed over and against the two main strands of Western epistemology—realism and idealism. Both of these traditions are based on the shared assumption of mental representation. In the former case, representation is used to recover an external world, while in the later it is used to project the internal world of the mind onto the exterior world.[22] Varela *et al.* believe that they can side-step many of the epistemological questions endemic to Western philosophy by rejecting altogether the idea of cognition as representation. Instead, cognition is seen as "embodied action." By this they highlight two things. First, cognition cannot, as in cognitivism, be discussed in abstraction from its physical manifestation. Cognition is intimately related to the kinds of experiences available to the particular kinds of physical beings that humans are. This includes not only human biology, but also psychological and cultural contexts. Second, cognition is a form of action. That is, sensory and motor processes are inseparable: cognition is a lived process.[23]

For Varela *et al.*, the view of mind is based on an underlying Buddhist philosophy. This philosophy, articulated most fully by Nagarjuna, argues that nothing has independent existence; all being arises co-dependently.[24] This idea of interdependence finds a modern counterpart in ecology, but in the Buddhist context it takes on metaphysical significance. The claim is not simply that all things are related to other things, but that this relationality precludes the idea of any "thing" having truly independent existence. This ontology is the basis for the rejection by Varela *et al.* of the dualism inherent in cognitivism. Knower and known are not separated but are, in fact, intimately related. Thus, the epistemology implied by their "enactionist" philosophy of mind is very different from critical realism. Knowledge is not preexistent, but is "enacted in particular situations."[25]

Critical realism, it must be noted, also denies a simplistic idea of preexisting knowledge—that is, facts about the world that exist independent of the knower. This is the view it ascribes to naïve realism. Critical realism acknowledges that human knowers play some role in knowledge "construction," hence the provisional status it accords to human knowledge. The "constructive" role of the knower, however, is a rather modest one. Peacocke argues that the human role in the generation of knowledge is limited by subjecting knowledge-claims to critical evaluation.[26] This process, on a realist account, can bring theories into better and better accord with the way things "actually" are. It is important for critical realists to limit the human contribution in this way. Peacocke sees the strong program in the sociology of knowledge as an example of what happens when the human input to knowledge-claims goes unchecked. He sees such programs as undermining fruitful dialogue between science and religion, because all truth claims degenerate into ideological commitments. The end result is that the science-and-religion dialogue would become nothing more than "a purely sociological inquiry or exercise in the history of ideas."[27]

The sociology of knowledge claims that* theories about the world *are heavily influenced by socio-cultural factors, but it does not make the more radical claim that the world "itself" is altered in any direct sense by the way one knows it. Enactionism, on the other hand, does make this more radical claim.

Does enactionism run into the same problem because of its emphasis on the role of the knower? It seems that it does not. The sociology of knowledge rejects the idea that one can have "objective" knowledge, because it rejects the idea that one can have unmediated access to the world "out there." In this claim, enactionism is similar to critical realism. But whereas critical realism, based on an underlying realist ontology, claims that there is a world "out there" that knowledge can come closer and closer to approximating, the strong program of the sociology of knowledge rejects this progressionist vision of science. One's theories always are, and always will be, heavily reflective of one's own socio-cultural biases.[28]

Both critical realism and the sociology of knowledge share a Western philosophical perspective in which there is a one-way divide between epistemology and ontology—while ontology may influence epistemology, epistemology does not affect ontology. The sociology of knowledge claims that *theories about the world* are heavily influenced by socio-cultural factors, but it does not make the more radical claim that the world "itself" is altered in any direct sense by the way one knows it. Enactionism, on the other hand, does make this more radical claim. The coupling that takes place between knower and known means that there is "no fixed, permanent substrate or foundation" to the world; there is no objective world for theories to be about in isolation from those who hold the theories.[29] Note that the claim here is not that there is no "objective" world, but rather that such a world must include human knowers in their activity as knowers. "Objectivity," in the sense of "the world as it is in itself," is redefined in a way that removes the subject-object split.

By shifting away from a worldview based on the assumptions of Western philosophy, enactionism avoids Peacocke's fear that a thoroughgoing involvement of the knower in the production of knowledge implies a loss of objectivity. It does, however, require that objectivity as it is postulated in Western thought be reconsidered. What does this mean for the science and religion dialogue? Could enactionism be as productive for meaningful dialogue as critical realism? Given Barbour's claim that scientists generally are realist in their view of science,[30] a theory that challenges realist ontology could undermine the credibility of the dialogue among the scientific community. A review of the literature on realism in the philosophy of science, however, seems to question whether scientists can so easily be identified as realists.[31] If this is the case, enactionism should not be rejected simply because it challenges traditional notions of "objectivity" based on realism. In fact, enactionism's view of the process of cognition as a coupling of knower and known, and its emphasis on the influence of biological, psychological, and cultural contexts on this coupling, make it necessary to take all facets of human experience seriously. Thus, not only does enactionism support the idea of dialogue between science and religion, it would expand this to include other areas of human endeavor, such as art.

An enactionist approach might also be more inviting to religions other than Christianity, Judaism, and Islam—religions, that is, that do not share a Western understanding of personhood. I have challenged the dominance of critical realism in so far as its adoption has been the result of structural similarities to a particular religious tradition, namely Christianity. To be fair, it must be asked whether enactionism, with its roots in Buddhism, would appeal mainly to Buddhists. If so, this would cast doubt on the idea that it would be more appropriate to a variety of religions than critical realism is.

In an attempt to bring theological ideas of what the person is into harmony with modern science, many Christian theologians have emphasized that the Bible presents humans as psychosomatic unities—both body and soul. This can be understood to mean simply that I am a soul residing inside a body. However, it can also be given a more integrative interpretation in which body and soul are intertwined, and "I" am not myself without both. The latter is the view of those who wish to bring theological anthropology more in line with science. This view of the person would not, I believe, have the difficulties with enactionism that the former might. If this is the case, then at least those Christians holding the more integrative view who are engaged in the science-and-religion dialogue should not feel alienated by enactionism.

These brief reflections on the possibilities of enactionism for the science-and-religion dialogue are not intended to argue that it is the best approach. Rather, the point is to question the dominance of critical realism, in part by exploring a different epistemology. Realism in general, much less critical realism in particular, has not achieved normative status in philosophy. Thus, its dominance in the field of science and religion seems somewhat peculiar. For those who go far enough to call it a "dogma," critical realism's prevalence seems incongruous with its own spirit of holding all theories as tentative.[32] That is not to say, however, that critical realism should be rejected outright. It has worked fairly well for the science-and-religion dialogue. From the religious side, its view of the mind and insistence that it is intelligibility, not observability, that is the determining factor in ascribing "reality," allow for a smooth integration with

Christian theology. The emphasis on intelligibility also makes sense from the perspective of science—especially physics, which has been one of the most significant participants in the dialogue from the science side. As the dialogue becomes more diverse religiously, however, new resources, like enactionism, will come to the attention of Western scholars and could take the dialogue in new and exciting directions. This should not come at the expense of critical realism. Having multiple epistemologies active in the science-and-religion dialogue would, I believe, be more fruitful than having the dialogue dominated by a single perspective, whatever it may be.

Works cited:

Andresen, Jensine. Lecture for "Religion and Science: Cosmology and Beyond." Boston University (September 1999).

Barbour, Ian. *Issues in Science and Religion*. Englewood Cliffs, N.Y.: Prentice-Hall, 1966.

_____. *Religion and Science: Historical and Contemporary Issues*. San Francisco: HarperSanFrancisco, 1997.

Fine, Arthur. "Scientific Realism and Antirealism." In *Routledge Encyclopedia of Philosophy*, ed. by Edward Craig, 581-84. New York: Routledge, 1998.

Gregersen, Niels Henrik, and J. Wentzel van Huyssteen, eds. *Rethinking Theology and Science: Six Models for the Current Dialogue*. Grand Rapids: Eerdmans, 1998.

Hacking, Ian. "Experimentation and Scientific Realism." In *The Philosophy of Science*, ed. by Richard Boyd, Philip Gasper, and J. D. Trout, 247-60. Cambridge, Mass.: MIT Press, 1991.

Knorr-Cetina, Karin. *Epistemic Cultures: How the Sciences Make Knowledge*. Cambridge, Mass.: Harvard University Press, 1999.

Lakoff, George, and Mark Johnson. *Philosophy in the Flesh: The Embodied Mind and Its Challenge to Western Thought*. New York: Basic Books, 1999.

Peacocke, Arthur Peacocke. *Theology for a Scientific Age: Being and Becoming—Natural, Divine and Human*, enlarged edition. London: SCM, 1993 [1990].

Ramsperger, A. G. "Critical Realism." In *Encyclopedia of Philosophy*, vol. 2, ed. by Paul Edwards, 261-63. New York: Macmillan, 1972.

Robbins, J. Wesley. "Pragmatism, Critical Realism, and the Cognitive Value of Religion and Science." *Zygon: Journal of Religion and Science* 34 (1999): 656-7.

Soskice, Janet. "Knowledge and Experience in Science and Religion: Can We Be Realists?" In *Physics, Philosophy and Theology: A Common Quest for Understanding*, ed. by Robert John Russell, William R. Stoeger, S.J., and George V. Coyne, S.J. Vatican City State: Vatican Observatory, 1988.

Varela, Francisco J., Evan Thompson, and Eleanor Rosch. *The Embodied Mind: Cognitive Science and Human Experience*. Cambridge, Mass.: MIT Press, 1991.

Endnotes:

1. Barbour, *Issues in Science and Religion*, p. 264.
2. Ibid., p. 268.
3. Gregersen and van Huyssteen, p. 8.
4. Ibid., pp. 2, 52.
5. Hacking, pp. 256-59.
6. Barbour, op. cit., p. 157.
7. Ibid., pp. 156-7.
8. Lakoff and Johnson, pp. 45ff.
9. Ibid., p. 123.
10. Soskice, p. 177.
11. Ibid., p. 178.
12. Ibid.
13. Ibid.

14. Barbour, op. cit., p. 168.

15. Ibid., p. 170.

16. Peacocke, *Theology for a Scientific Age*, pp. 3-6.

17. Ramsperger, p. 261.

18. Robbins, pp. 656-7.

19. Andresen.

20. Robbins, p. 657.

21. See, e.g., Varela et al.

22. Ibid., p. 172.

23 Ibid., pp. 172-73.

24 Ibid., pp. 217ff.

25 Ibid., p. 179.

26 Peacocke, pp. 19-20.

27. Ibid., p. 19.

28. See, e.g., Knorr-Cetina.

29. Verala et al., p. 217.

30. Barbour, *Religion and Science*, p. 177.

31. See, e.g., Fine.

32. Robbins, p. 656.

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The New England Center for Faith and Science Exchange awarded Mr. Maslowe a year-2001 Publication Prize for this essay.

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Resisting the Lure of Certainty, Seeking the Unity of Truth: A Nineteenth-Century Voice with Twenty-first-Century Resonance

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In her essay, the author seeks to bring the vision of nineteenth-century American philosopher Charles Sanders Peirce to the attention of those involved in the contemporary debate over the relationship between religion and science. Peirce's conception of a "scientific religion" and the openness of a scientific integrated with the human experience of the divine as a way of overcoming the equating of truth with rigid certainty is of particular relevance today, when the dangers of fundamentalist biblical interpretation are especially evident.

Introduction

A recent article in the *Financial Times*, a major international newspaper, carried the headline "Religious repression—western style." In describing the debate over embryonic stem-cell research, the author Thomas Barlow lamented the tendency of many in the "secular" west "to impede the use of embryos for research into regenerative medicine," based "largely on parochial religious grounds." [1] One can imagine the nineteenth-century American philosopher Charles Sanders Peirce (1839-1914) shaking his head. Such an article suggests that opposing conceptions of what constitutes truth continue to drive a wedge between religion and science, nearly one hundred years after he passionately argued for a unified religion and science to overcome the human tendency to define truth in terms of narrow certainties. Peirce saw the method of science as enabling the pursuit of truth in its broadest and fullest sense, by emphasizing the openness to new ideas that was its leading characteristic.

Although he is a nineteenth-century thinker, Peirce's ideas on the relationship between science and religion and the danger posed by the lure of certainty to the search for knowledge are strikingly relevant oday, whereas the work of many of his contemporaries retains only historical interest. In contrast to Andrew Dickson White, who lauded the triumph of science over theology, which he considered to be backward and conservative, and to William James, whose psychological approach relegated religion wholly to the sphere of individual experience, Peirce approached the problem of the relation of science and religion from a philosophical and logical standpoint. Peirce concluded that a specific type of fundamentalism, that which is characterized by the prioritizing of certainty over all other measures of truth, was the cause of all intellectual stagnation. In seeking to understand why the rigid conservatism of this kind of fundamentalism was attractive, and what it was that made religion particularly prone to it, Peirce devoted considerable time and thought to the examination of the basic nature of belief and doubt and why individuals preferred certainty of belief to all other considerations. Using this basic philosophic examination as a foundation, he drew also on his experience as an experimental scientist to find a way by which the subjective nature of religious conviction might be integrated with the rational thought processes of science.

In this essay I will analyze Peirce's writings on the relationship between religion and science to draw out the major elements of his vision for the integration of the two. In doing so, I will mainly focus on Peirce's own work, but will also make occasional reference to White's and James's ideas as a way of contrasting Peirce with other contemporary thinkers who were also working on the problem. I begin with a brief overview of Peirce's background, and then move on to an analysis of how he drew on his essays on belief and doubt as the foundation for his later work on the relationship between religion and science and his arguments for the reality of God. In providing an in-depth look at Peirce's vision of "scientific religion," I hope to show that his ideas, although a century old, provide a valuable and relevant intellectual approach to today's discussions about how religion and science might join together in the pursuit of truth.

Peirce recognized that religion is not just an outmoded form of philosophical belief that had given way to the intellectual progress of science. Religion is something for which no purely rational system, not even the most spirited science, can serve as a substitute or replacement.

Charles Sanders Peirce in Context

Charles Sanders Peirce was born in Cambridge, Massachusetts, on 10 September 1839 and was exposed to an intellectually stimulating environment from his birth. His father was Benjamin Peirce, professor of mathematics at Harvard and well known in America and Europe for his mathematical work; Boston's leading intellectuals frequented the Peirce home in Cambridge.[2] Peirce was a precocious child, a trait no doubt enhanced by his father's specially devised program of studies designed to cultivate his natural "genius;" but his formal academic career was undistinguished with the exception of his chemistry degree, which was the first *summa cum laude* degree ever awarded by the newly established Lawrence Scientific School at Harvard University. His scientific work at the United States Coastal and Geodetic Survey provided his most steady employment throughout his life; unlike many other American thinkers with whom he was contemporary, Peirce seemed unable to hold down a university position.[3] The reasons for this inability are not entirely clear, although the unconventionality of his ideas and his indiscreet social behavior were probably factors.[4] The non-conformity of his personality was compounded by his well-documented erratic temperament and behavior, largely the result of the periodically disabling condition of facial neuralgia, the excruciating pain of which he relied on opium and later morphine and cocaine to relieve.[5] Yet Peirce's lack of professional success did not stop him from becoming well versed in, and writing extensively on, a wide variety of subjects including logic, mathematics, the physical sciences, metaphysics, and religion and philosophy.

Peirce's early interest in how belief came to be established is evident in his essays on logic of science published in *Popular Science Monthly* in 1878; but he gave new prominence to his understanding of the relationship of religion to science somewhat later, beginning in 1893 with his essay, "The Marriage of Religion and Science," and his vision for the integration of subjective religious experience and rational analysis in the 1908 piece, "A Neglected Argument for the Reality of God." The links between the early logical work and his later writing on "scientific religion" are unmistakable, as Peirce's own annotations and revisions demonstrate. Yet this side of Peirce's work could be called his own "neglected argument." Rarely, it seems, are his ideas on religion and science taken as a serious component of his philosophical vision. It is not uncommon in scholarship about Peirce to see his writings on science and religion described as being the work of a "second Peirce," a seemingly different thinker than the one who wrote extensively on logic, mathematics, and philosophy.[6] Even the editors of his collected papers, philosophers Charles Hartshorne and Paul Weiss, in their introduction to volume 6 of the series, remark:

> The second book of the volume, devoted to religion or "psychical metaphysics," has rather tenuous connections with the rest of the system, offering, apart from scattered flashes of insight, views which have a sociological or biographical, rather than a fundamental systemic interest.[7]

These views of Peirce's writings on science and religion obscure or sever entirely the connections that Peirce himself saw between this topic and his other writings. Peirce envisioned his philosophical system as describing the unity of *all* truth, including that of science and religion.

The Marriage of Religion and Science

According to Peirce's generalizations in his essay, "The Marriage of Religion and Science," science and religion had evolved in ways that made them naturally antagonistic. Science is essentially open and forward-looking, while religion remains cautious and conservative. In the presentation of his argument for a "scientific religion," Peirce first examined science as the source of religion's reinvigoration. The essence of science is "the scientific spirit, which is determined not to rest satisfied with existing opinions but to press on to the real truth of nature." The spirit of science for Peirce is not primarily tied up with the production of what might be called scientific results or knowledge. Knowledge might be no more than "a dead memory; while by science we all habitually mean a living and growing body of truth."[8] Science is, rather, an openness, even a desire to have one's ideas and beliefs continually disproved in the hope that such reforming of belief was little by little bringing humanity closer to true knowledge. Peirce's vision of the spirit of science was an optimistic one. He thought that this unified truth toward which science was continually approaching but never fully reaching *was* accessible, if investigation could be carried to its fullest extent, something that conceivably could take an unlimited amount of time. In an annotation made in 1893 to his 1878 essay, "How to Make Our Ideas Clear," he wrote:

> [W]e are all putting our shoulders to the wheel for an end that none of us can catch more than a glimpse at—that which the generations are working out. But we can see that the development of embodied ideas is what it will consist in.[9]

New truths are not just theoretical—they are ideas that are embodied, entailing new ways of behaving. On the subject of progress in religion, however, he wrote:

> Religion, from the nature of things, refuses to go through her successive transformations with sufficient celerity to keep always in accord with the convictions of scientific philosophy.[10]

The Christian religion is often inherently conservative, he observed, afraid to accept new innovations in science or other fields. Peirce thought that religion's greatest flaw is that it puts security and certainty before the desire for seeking true belief. In embracing its inherent conservatism, Christianity had become preoccupied with constructing defensive structures of creeds and dogmas against not only external threats from science and philosophy but also internal divisions between groups with differing viewpoints. But this view was not Peirce's only conception of religion. Unlike his contemporary Andrew Dickson White, author of *A History of the Warfare of Science with Theology in Christendom* and a founder and first president of non-sectarian Cornell University, Peirce did not believe that the entrenched conservatism of religion necessitates its complete subordination to scientific systems of knowledge.

White saw the "conquest" of religion by science reducing religion to a mere evolutionary step in the upward ascent to truth of which science was the leading edge.

> Modern science, in substituting a new heaven and a new earth for the old—the reign of law for the reign of caprice, and the idea of evolution for that of creation—has added and is steadily adding a new revelation divinely inspired.[11]

In contrast, Peirce recognized that religion is not just an outmoded form of philosophical belief that had given way to the intellectual progress of science. Religion is something for which no purely rational system, not even the most spirited science, can serve as a substitute or replacement. He wrote:

> Religion is a life [and] can be identified with a belief only provided that belief be a living belief—a thing to be lived rather than said or thought.[12]

Religion is a thing to be lived rather than said or thought, because unlike philosophy or science it was predicated on a direct intuition of God's reality.

> [W]hen a man has that experience with which religion sets out, he has as good reason—putting aside metaphysical subilties [*sic*]—to believe in the living personality of God as he has to believe in his own. Indeed, *belief* is a word inappropriate to such direct perception.[13]

Religion had not only fallen behind the progress of science, but it had also become divorced from its own source: experience. Peirce, like his contemporaries John Draper and White, saw the theological side of religion as the greatest restriction on its vitality.[14] Yet, unlike the others, he did not see the solution in condemning the Church as a whole. The key problem Peirce saw for religion was the influence of those who made certainty and precision the hallmark of religious truth. Here Peirce's "commonsensism" as he called it, came to the fore. The truth found by applying the spirit of science to religion would not necessarily be precise truth, Pierce thought; a less precise understanding is often superior.

> No concept, not even those of mathematics, is absolutely precise; and some of the most important for everyday use are extremely vague. Nevertheless, our instinctive beliefs involving such concepts are far more trustworthy than the best established results of science, if these be precisely understood.[15]

A belief more open to metaphor and imprecision resonates as genuinely true to experience far more often than does rigid dogma, Peirce argued.

He sought to renew religion through an infusion of the open and truth-seeking spirit of science, which would restore the importance of religious experiences, rather than requiring religion continually to reduce its claims to authority in the face of skeptical and rationalist critiques. He detailed his vision in terms of the "man whom religious experience most devoutly moves":

> While adhering to the essence of religion, and so far as possible to the church, which is all but essential, say, penessential, to it, he will cast aside that religious timidity that is forever prompting the church to recoil from the paths into which the Governor of history is leading the minds of men, a cowardice that has stood through the ages as the landmark and limit of her little faith, and will gladly go forward, sure that truth is not split into two warring doctrines, and that any change that knowledge can work in his faith can only affect its expression, but not the deep mystery expressed.[16]

This attitude would be "a religion of science," meaning not, Peirce was clear, Christianity replaced by the worship of science, for "religion, in the proper sense of the term, can arise from nothing but the religious sensibility." Rather, it would be a religion so assured of its own worth that "it becomes animated by the scientific spirit, confident that all the conquests of science will be triumphs of its own." [17] Peirce's vision of scientific religion was one in which neither reason nor experience dominates, but both are brought together to create a living belief. Certainty of religious belief comes in the short term through experience, but in the long term through the refinement of that experience through continual communal interpretation and evaluation.

Fixing Belief through the Method of Science

What were Peirce's grounds for laying so much weight upon science and the scientific method as the superior method for settling on a true belief? Peirce's interest in belief and how it came to be settled upon was central to his philosophical and logical theory of pragmatism, with its emphasis on the practical results of ideas.[18] In his essay, "The Fixation of Belief," Peirce described belief:

> Our beliefs guide our desires and shape our actions.... The feeling of believing is a more or less sure indication of there being established in our nature some habit which will determine our actions.[19]

In contrast to belief, doubt does not establish a pattern of future action, but rather incites the process of settling on a belief.

> Doubt is an uneasy and dissatisfied state from which we struggle to free ourselves and pass into the state of belief, while the latter is a calm and satisfactory state which we do not wish to avoid, or to change to a belief in anything else.[20]

To avoid settling for early certainty in the fixing of religious belief, Peirce believed it might be necessary to use the method of science to push oneself to question continually, even when other methods of fixing belief might appear to have settled the matter. Peirce knew that it was tempting to stay with beliefs learned early in life (a method he referred to as "tenacity") or to embrace those imposed upon a community by authority, such as the Church, or by *a priori* philosophical assumptions. However, Peirce noted that although these methods may occasionally come up with the correct belief, there is no guarantee, linked as they are to the vagaries of human desires for certainty and security.[21] What is needed truly to satisfy doubts is a method that enables beliefs to be determined "by nothing human, but by some external permanency—by something upon which our thinking has no effect.... Such is the method of science." [22]

The method of science provides a guard against the human temptation to settle for just any belief that appeared to assuage the unease of doubt, by providing a structured means of testing experience; and, therefore, it was central to Peirce's logical approach to the problem of the relation of religion and science. Whereas his close friend William James's psychological slant on belief stressed the "unsharable feeling which each one of us has of the pinch of his individual destiny [as] the one thing that fills up the measure of our concrete actuality," thus making individual experience the essential foundation of true ideas,[23] Peirce combined his support of the role of empirical experiences in the fixation of belief with a conviction of the necessity of a method for critically analyzing those experiences. The concept of "abduction" was one of Pierce's key innovations in his vision of the application of the method of science to religion, and it is the tie that binds science and religion together. Abduction for Peirce is distinct from his conceptions of induction and deduction, although he saw the three as connected.[24] In his sixth "Lecture on Pragmatism," entitled "Three Types of Reasoning," given in 1903, Peirce defined the three modes of logical thought:

The truth found by applying the spirit of science to religion would not necessarily be precise truth, Pierce thought; a less precise understanding is often superior. A belief more open to metaphor and imprecision resonates as genuinely true to experience far more often than does rigid dogma.

> Abduction is the process of forming an explanatory hypothesis. It is the only logical operation which introduces any new idea; for induction does nothing but determine a value, and deduction merely evolves the necessary consequences of a pure hypothesis. Deduction proves that something *must* be; Induction shows that something *actually is* operative; Abduction merely suggests that something *may be*.[25]

Abduction is able to suggest new ideas as explanatory hypothesis:

> [Abduction is a kind of] perceptual judgment.... It is an act of *insight* although of extremely fallible insight. It is true that the different elements of the hypothesis were in our minds before; but it is the idea of putting together what we had never before dreamed of putting together which flashes the new suggestion before our contemplation.[26]

A new experience triggers this abductive flash of insight. Once the abductive explanation has been produced based on the singular experience, deduction and induction (Peirce often equated the latter to the more general idea of a "course of experimental investigation") are used to test the hypothesis.[27] Within pragmatic logic, abduction brings forward those hypotheses that might potentially modify practical action, while eliminating those that would have no distinctive effect on conduct from consideration.[28]

Peirce's call for the openness of science to new truth to be applied to religion and his simultaneous assertion of the validity of human spiritual experience are two sides of the same anti-dogmatic coin.

Abduction, the Method of Science and the Neglected Argument

In 1908, Peirce published an extended essay entitled "A Neglected Argument for the Reality of God." In it, he described his theory of how the direct experience of God that is the root of individual religious belief intersects with the method of science, specifically its abductive aspect. Peirce began his essay with his idea of "musement," a sort of meditation in which the individual allows his or her mind to wonder freely at the nature of the universe. Eventually, according to Peirce, the interaction among the various aspects of the universe would "inevitably suggest the hypothesis of God's Reality."[29] Musement is, therefore, a form of abduction, producing possible and plausible explanatory hypotheses to explain unusual individual experiences. Furthermore, Peirce was clear that the scientific method is initially applied to the reality of God in the same way that it is applied to any object of thought. Knowledge of God is not specifically to be sought. Any *a priori* assumptions about what would be found or even what was being looked for must be discarded before beginning the process of generating abductive hypotheses through musement.

> One who sits down with the purpose of becoming convinced of the truth of religion is plainly not inquiring in scientific singleness of heart, and must always suspect himself of reasoning unfairly.[30]

Yet the hypothesis of God is different from other abductive hypotheses, Pierce thought, for it is more than a theoretical idea for the muser. Whereas in general cases of abduction, the hypothesis is suggested inferentially from a surprising experience and then tested, in the case of religious experience the initial experience that suggested the abductive hypothesis of the existence of God is so persuasive that less rigorous testing of the hypothesis is required—the hypothesis could be verified by observing the practical transformation of the life of the muser. Drawing on his earlier ideas of 1893 that religion was not merely a belief, but a *living* belief, Peirce described the hypothesis of God generated by musement as affecting the individual with a desire "above all things to shape the whole conduct of life and all springs of action into conformity" with it.[31] The hypothesis of God is created through the same method of science as all logical hypotheses for belief, but it is distinct in its transforming effect on the muser.

However, even such transforming experience requires logical analysis to guard against the natural human desire for security and certainty. This logical analysis was to be tailored in its level of precision to the object. The hypothesis of God presents the muser with an unusual object of hypothesis:

> [I]t supposes an infinitely incomprehensible object, although every hypothesis, as such, supposes its object to be truly conceived in the hypothesis. This leaves the hypothesis but one way of understanding itself; namely, as vague yet as true so far as it is definite, and as continually tending to define itself more and more, and without limit.[32]

The hypothesis of God, thus, could not to be subject to the same kind of precise experiments that other abductive explanations could, but Peirce still believed it could be critically analyzed. His solution was his theory of pragmatism, or pragmaticism as he was calling it by this point. Pragmaticism was Peirce's flexible method of testing ideas of varying precision and levels of definition. The trained man of science, Peirce said, would test the hypothesis of God:

> ...taking his stand upon Pragmaticism, which implies faith in common sense and in instinct, though only as they issue from the cupelfurnace of measured criticism. In short, he will say that the N. A. [neglected argument] is the First Stage of a scientific inquiry, resulting in a hypothesis of the very highest Plausibility, whose ultimate test must lie in its value in the self-controlled growth of man's conduct of life.[33]

The hypothesis of the reality of God conforms to the early stages of scientific inquiry, but given that it cannot be fully comprehended by the individual, and thus cannot be subject to definite deductive and inductive tests, its usefulness and value can only be determined by its transforming effects on the individual's way of living. Peirce had returned once again to "the sole principle of logic which was recommended by Jesus: "Ye may know them by their fruits," thus making abduction "intimately allied with the ideas of the gospel.[34] Applying the method of science to religion made it evident that it was how one lived, not creeds and dogmas ascribed to, that was the hallmark of religious belief.

Conclusion

Charles Sanders Peirce presents a vision of the integration of religious experience with scientific reason unlike any other offered by his nineteenth-century contemporaries; and even today, his logical approach to the problem of the relations between science and faith is unique among the varied ideas that form the debate. Rather than casting religion as the fossil of an earlier stage of humanity's moral development, as Andrew Dickson White did, or considering it as an aspect of individual psychology and, thus, wholly separate from the work of science, Peirce's emphasis on how belief is formed enabled him to envision a relationship in which religion and science were equal and integrated partners. His stress on the interplay of experience and reason as both valid and necessary elements of the pursuit of truth enabled him to overcome the trap of equating truth with certainty and "anything goes" relativism. Peirce saw his vision of "scientific religion" as maintaining the integrity of both religion and science, while allowing them to be brought together. As he described in "The Marriage of Religion and Science":

> It is a religion, so true to itself, that it becomes animated by the scientific spirit, confident that all the conquests of science will be triumphs of its own, and accepting all the results of science, as scientific men themselves accept them, as steps towards the truth, which may appear for a time to be in conflict with other truths, but which in such cases merely await adjustments which time is sure to effect. This attitude, be it observed, is one which religion will assume not at the dictate of science, still less by way of a compromise, but simply and solely out of a bolder confidence in herself and in her own destiny.[35]

Peirce's call for the openness of science to new truth to be applied to religion and his simultaneous assertion of the validity of human spiritual experience are two sides of the same anti-dogmatic coin. Both aspects of his "scientific religion" guard against the lure of settling for certainty, and each serves as a check on the dominance of the other. In the long term, it is this relinquishment of certainty in favor of the pursuit of truth that will invigorate both science and religion. In his 1878 essay, "The Fixation of Belief," Pierce noted:

> All those [systems] which repose heavily upon an "inconceivability of the opposite" have proved particularly fragile and short lived. Those, however, which rest upon positive evidences, and which avoid insisting upon the absolute precision of their dogmas are hard to destroy.[36]

Works cited:

Barlow, Thomas. "Religious repression—western style." *Financial Times* (December 8/December 9 2001), Weekend section, II.

Brent, Joseph. *Charles Sanders Peirce: A Life.* Bloomington and Indianapolis: Indiana University Press, 1993.

Goudge, Thomas A. *The Thought of C. S. Peirce.* New York: Dover Publications Inc., 1950.

Hartshorne, Charles, and Paul Weiss. "Introduction." In *The Collected Papers of Charles Sanders Peirce*, ed. by Charles Hartshorne and Paul Weiss. Cambridge, Mass.: Harvard University Press, 1935.

James, William. *The Varieties of Religious Experience.* New York: Penguin Classics edition, Penguin Books, 1985.

Menand, Louis. *The Metaphysical Club: A Story of Ideas in America.* New York: Farrar, Straus and Giroux, 2001.

Pierce, Charles Sanders. "The Fixation of Belief" (1878). In *The Collected Papers of Charles Sanders Peirce*, ed. by Charles Hartshorne and Paul Weiss, vol. 5, 223-247. Cambridge, Mass.: Harvard University Press, 1935.

_____. "How to Make Our Ideas Clear" (1878). In *The Collected Papers of Charles Sanders Peirce*, ed. by Charles Hartshorne and Paul Weiss, vol. 5, 248-271. Cambridge, Mass.: Harvard University Press, 1935.

_____. "The Marriage of Religion and Science" (1893). In *The Collected Papers of Charles Sanders Peirce*, ed. by Charles Hartshorne and Paul Weiss, vol. 6, 302-304. Cambridge, Mass.: Harvard University Press, 1935.

_____. "What is Christian Faith?" (1893). In *The Collected Papers of Charles Sanders Peirce*, ed. by Charles Hartshorne and Paul Weiss, vol. 6, 305-309. Cambridge, Mass.: Harvard University Press, 1935.

_____. "Three Types of Reasoning" (1903). In *The Collected Papers of Charles Sand-*

ers Peirce, ed. by Charles Hartshorne and Paul Weiss, vol. 5, 94-111. Cambridge, Mass.: Harvard University Press, 1935.

_____. "Pragmatism and Abduction" (1903). In *The Collected Papers of Charles Sanders Peirce*, ed. by Charles Hartshorne and Paul Weiss, vol. 5, 112-131. Cambridge, Mass.: Harvard University Press, 1935.

_____. "Answers to Questions Concerning My Belief in God" (c. 1906). In *The Collected Papers of Charles Sanders Peirce*, ed. by Charles Hartshorne and Paul Weiss, vol. 6, 340-355. Cambridge, Mass.: Harvard University Press, 1935.

_____. "A Neglected Argument for the Reality of God" (1908). In *The Collected Papers of Charles Sanders Peirce*, ed. by Charles Hartshorne and Paul Weiss, vol. 6, 311-339. Cambridge, Mass.: Harvard University Press, 1935.

Smith, John E. *The Spirit of American Philosophy*. New York: Oxford University Press, 1963; Galaxy Books, 1966.

White, Andrew Dickson. *A History of the Warfare of Science with Theology in Christendom*. London: Arco Publishers Limited, 1955 [1896].

Endnotes:

1. Barlow.

2. Brent, pp. 27, 30, 45.

3. Ibid., p. 3.

4. One example of Peirce's social indiscretion was his very public affair and cohabitation with his second wife prior to both his divorce from his first wife and his remarriage. To add to the scandal was his second wife's mysterious background, including an unsubstantiated claim that she was a Hapsburg princess. See Menand, pp. 281-82.

5. Brent, pp. 156, 39-41; Menand, p. 159.

6. Goudge, pp. 5-7.

7. Hartshorne and Weiss, p. v.

8. Peirce, "The Marriage of Religion and Science," para. 428. (Citations from this series give the paragraph number, the convention for this edition of Pierce's collected papers.)

9. Peirce, "How to Make Our Ideas Clear," para., footnote 2.

10. Peirce, "The Marriage of Religion and Science," para. 432.

11. White, p. 23. Although White's title indicates that his was directed to theology, lines such as the ones quoted here which appear throughout the book suggest that White envisioned science as replacing more than simply theology.

12. Peirce, "What is Christian Faith?" para. 439.

13. Ibid., para. 436.

14. John Draper, a contemporary of Andrew Dickson White and Charles Peirce, received much attention for his book, *History of the Conflict between Religion and Science* (1874). Draper saw the conflict between riligion and science as resulting from an inevitable clash between the two. Unlike Peirce and White, who both, to varying degrees, saw essential elements of religion as compatible with science, Draper saw all facets of religion as inhibiting the progress of science.

15. Peirce, "Answers to Questions Concerning My Belief in God," para. 496.

16. Peirce, "The Marriage of Religion and Science," para. 432.

17. Ibid., para. 433.

18. Peirce renamed the theory pragmaticism—a term he deemed too ugly to be "kidnapped"—in the later years of his life to distinguish his version of the doctrine from that of other American philosophers who had taken up his ideas. Menand, pp. 350-51; Smith, p. 6.

19. Peirce, "The Fixation of Belief," para. 371.

20. Ibid., para. 372.

21. Peirce, "The Fixation of Belief," para. 378, 379, 383.

22. Ibid., para. 384.

23. James, para. 499.

24. See Goudge, pp. 195-99, for a discussion of how Peirce over time came to see induction and abduction as two points on the spectrum of ampliative (amplifying, rather than explaining) inference, and the connection of the two with deduction.

25. Peirce, "Three Types of Reasoning," para. 171.

26. Peirce, "Pragmatism and Abduction," para. 181.

27. Peirce, "Three Types of Reasoning," para. 168.

28. Peirce, "Pragmatism and Abduction," para. 196.

29. Peirce, "The Marriage of Religion and Science," para. 465.

30. Ibid., para. 458.

31. Ibid., para. 467.

32. Ibid., para. 466.

33. Ibid., para. 480.

34. Peirce, "How to Make Our Ideas Clear," para. 402, footnote 1 (1893). John E. Smith points out that here Peirce might be drawing on an idea prominent in seventeenth and eighteenth century American Calvinist Puritanism, that any individual might deceive themselves and others of their beliefs, and so real outward evidence of transformation was a necessary corollary of professed belief. See Smith, p. 18.

35. Peirce, "The Marriage of Religion and Science," para. 433.

36. Peirce, "The Fixation of Belief," para. 376.

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Subjectivity and Objectivity in Science and Religion

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Subjectivity and objectivity are interdependent in both science and religion. In each discipline, objectivity is based on subjectivity, then structured and communicated within paradigms developed by a community. Nonrational thought is vital to both disciplines, and each relies on non-provable assumptions. Thus, although religion and science investigate reality from different perspectives, their methods are fundamentally similar.

Science and religion coexist in an uneasy relationship. Although each one claims to be engaged in a search for truth, they rarely interact, and scientists and theologians conduct their work without regard for one another. Since it is commonly assumed that they use different methods and pursue different goals, their relationship is usually one of mutual toleration, although occasionally outright hostility erupts between them. A number of scientists and theologians and at least one mainline Christian denomination have recently called for conversation between the two disciplines.[1] To begin this interdisciplinary dialogue, the methods and limitations of each discipline must be critically assessed by both groups so that points of contact, if not of agreement, can be noted. The lack of such interdisciplinary evaluation inevitably leads each discipline to misunderstand and misrepresent the other.

Fundamental to any scientific or theological method of inquiry is the interrelationship between objectivity and subjectivity. Both attitudes are essential in the encounter of the thinking individual with reality. They are frequently assumed to be irreconcilable opposites. Since the Enlightenment, the emphasis on reason in Western thought has been enormous. Objectivity in scientific investigation is assumed to lead to an accurate understanding of reality; subjectivity is thought to contaminate such investigation and lead to illusion. While logic and objectification, considered to be rational, are trusted and held in intellectual esteem, the nonrational subjectivity of emotion, intuition, and religious experience is denigrated and viewed with suspicion. The two are, however, intimately related, and their interdependence is foundational to both scientific and theological method.

The essence of the relationship between objectivity and subjectivity lies in the fact that reality must be subjectively experienced before it can be objectively described or communicated. There can be no objective consideration without prior experiential or existential encounter of some sort. This is true for both scientific investigations and religious thought. Associated with this subjective encounter is its unavoidable interpretation by the thinker. Experiences are always filtered, categorized, prioritized, and otherwise interpreted by the one who is experiencing them. Further, these interpretations are unique to the thinker, because they are influenced by his or her prior experiences and interpretations. Thus, there is no pure objectivity of thought that can be completely separated from the subjectivity of the thinker. In many cases, objective thought is initiated by a completely subjective experience that occurs without identifiable external influence. Such experiences include intuitive insights, hunches, and experiences of what religious thinkers call transcendent reality. These experiences frequently lead to holistic understanding of a sort that is not a result of sequential, rational thought. The logic of such knowledge and its connections with other concepts are recognized only subsequent to the experience, after a time of rational reflection.

Physicist Paul Davies has claimed that belief results from a combination of objectivity, subjectivity, indoctrination, and intuition.[2] This is true in science no less than in religion. In both disciplines, objectivity is predicated on individual subjectivity and influenced by the subjectivity of the community that includes the thinker. Belief includes not only religious convictions, but also conclusions that have been derived from experimental or mathematical methods. The scientific method is commonly understood to lead to completely objective knowledge. Such knowledge is thought to be unrelated to subjective experiences, since it is the product of repeatable experimentation and logical thought. The scientific process is indeed designed to control subjectivity, relying as it does on experiments repeated within a large community of scientists over a long period of time. However, subjectivity is an essential part of the scientific process. Far from eliminating subjectivity, science structures it. Unstructured experiences may lead to erroneous conclusions. The drinking straw appears to have a bend in it when viewed through a transparent glass half-full of water. But the conclusion that it is not actually bent is not a result of pure objective thought. Instead, other experiences are structured using similar drinking glasses, water, straws, and light. On the basis of those structured experiences (experiments), the conclusion is reached that the light illuminating the straw is bent (refracted), while the straw remains straight. Subjective experience is not eliminated, but organized so that more accurate descriptions of reality are achieved. Experimental science does not in fact rely on pure objectivity, but on intersubjective objectivity that allows repeatability within a scientific community and thus objective descriptions of the experiences.

There can be no objective consideration without prior experiential or existential encounter of some sort.

Subjectivity is necessary for the existence of science itself. Thomas Kuhn's pioneering thought concerning paradigms suggested that all science is performed within a dominant paradigm or perspective on reality.[3] Each paradigm shares common problems, values, and presuppositions, and unites members of a particular scientific community in their work. The adoption of a paradigm within which one's work will be conducted is ultimately nonrational, based as it is on personal judgments as to its adequacy as a conceptual framework for the scientists using it. An element of peer pressure is also involved, since any given scientific community has already chosen a paradigm to guide their work, and because inexperienced scientists are always educated within a particular scientific community. Thus, the choice of a paradigm within which any series of investigations will proceed is highly subjective.

Data interpretation is permeated with subjectivity. Physicist and theologian Ian

Barbour cites wide support for the position that no data are uninterpreted.[4] An interpretive framework guides even the experimental questions that are asked and the way in which the experiments are designed. Subjectivity is comprehensive, even insidious. Barbour has summarized the situation:

> Man supplies the categories of interpretation, right from the start. The very language in which observations are reported is influenced by prior theories. The predicates we use in describing the world and the categories with which we classify events depend on the kind of regularities we anticipate. The presuppositions which the · scientist brings to his enquiry are reflected in the way he formulates a problem, the kind of apparatus he builds, and the type of variable he considers important. [...] [T]heory... permeates observation.[5]

Scientific progress is heavily dependent on nonrational thought. Physiologist Robert Root-Bernstein notes that subjective factors such as "intimacy," "a feeling for the organism," and "personal engagement" of the scientist are crucial if real discovery is to take place.[6] A willingness to pay attention to the unexpected, together with a sense that one knows one's system "from the inside" are part of the basis for the intuition that is so important to scientific discovery. Root-Bernstein quotes biochemist Albert Szent-Gyorgyi: "Discovery consists of seeing what everyone has seen and thinking what nobody has thought."[7] The confines of objective logic are too limiting to allow "thinking what nobody else has thought." Subjective leaps outside the confines of rational thought are necessary if creative thought is to take place.

Finally, scientific investigation itself is based upon foundational presuppositions that must be subjectively accepted without objective investigation. Astronomer John Barrow lists nine assumptions concerning the nature of reality that must be made before the practice of science can proceed,[8] including such axioms as "The world can be analyzed locally without destroying its essential structure," and "Nature possesses regularities, and these are predictable in some sense." He quotes Michael Polanyi:

> The metaphysical presuppositions of science...are transcendental preconditions of methodological thinking, not explicit objects of such thinking; we think with them and not of them.[9]

Although science relies on proof, these axioms cannot be proved within the system of thought that makes use of them. This seeming paradox rests on the work of mathematician Kurt Gödel, who showed that no complex axiomatic system can be complete: there must always exist propositions within the system that can not be verified or falsified from within that system. Thus, a subjective affirmation of the truth of a set of non-provable propositions is foundational to science itself. As Barrow wryly notes:

> One would normally define a 'religion' as a system of ideas that contains statements that cannot be logically or observationally demonstrated. Rather, it rests either wholly or partially upon some articles of faith. Such a definition has the amusing consequence of including all the sciences and systems of thought that we know; Gödel's theorem not only demonstrates that mathematics is religion, but shows that mathematics is the only religion that can prove itself to be one![10]

The interrelationship of objectivity and subjectivity is foundational to religion as well, since every theological statement is based on a religious experience of some kind and influenced by the thinking of the faith community. Theology is the discipline that objectifies, organizes, and interprets these experiences in order that the transcendent reality or being (God) that caused them may be more fully understood. These experiences cannot be manipulated in the same way as can scientific experiments. The scientist controls experimental conditions to the end that particular variables are affected. This can be experienced (measured) by any other researcher who repeats the experiment. In religious experiences, in contrast, the divine influence upon the participant's experience cannot be controlled, nor can divine influence be quantified. The objective structure of worship, however, can be manipulated. Sacred enfironment and liturgy affect the subjective experience of the worshipping community, and their experiences can then be discussed objectively.

The task of theology is to construct an objective framework for understanding the human encounter with the reality that is revealed in and by the Divine. The fullness of God in Godself, however, is beyond human ability to conceptualize and describe. Barbour suggests that constructing religious models is the best that can be done; they are "human constructs that help us interpret experience by imagining what cannot be observed."[11] Any adequate theological method must admit that human objective, conceptual thought is limited and recognize that human subjectivity is the location of the divine-human encounter and is intimately entwined with all objective theological thought. Christian theologian Sallie McFague has suggested that theology functions most effectively when it uses metaphor to describe God and God's interactions with humanity in lieu of objective statements that are meant to be understood literally.[12] Metaphors use comparisons for God and God's activity that are grounded in human experience. However, by its very nature, metaphor is an incomplete comparison, incorporating both elements of "is" and "is not" in the comparison. While metaphor invites comparison, it does not define the reality with which the human experience is compared. Metaphor encounters reality without objectifying it, recognizes human conceptual limitations, and acknowledges that subjectivity permeates human thought.

In the same way that paradigms guide scientific communities in framing questions and in interpreting observations, paradigms also influence communities of religious believers in structuring their worship and in developing their theological metaphors. The structure of worship then further influences their subjective experience; and subsequent theological discussion is organized around dominant metaphors of who human beings are in relation to the Divine and the human-divine interaction. In theology as in science, the subjectively accepted paradigms of both the believer and the entire faith community (what may be called their intersubjectivity) influences the way that personal experience is objectified and understood.

Some religious experiences appear to arise spontaneously and manifest as a feeling of transcendence to the one who experiences them. Their appearance is unpredictable; they seem to appear randomly. A variety of types of these transcendental experiences have been described. They have occurred in every time period, ethnic group, and culture; to children as well as to adults. Their content, quality, and intensity vary, making their objectification and thus their analysis extremely difficult. The frame of reference of the individual experiencing them is sometimes changed completely, as in the case of sudden conversion experiences. An overwhelming flash of intuition frequently results in a complete reorientation of thought. The intuitive leap may result in a holistic understanding that leads the thinker in a logical direction entirely different from the one that was followed prior to the intuitive event. Thus, while the thinking consequent to the religious or intuitive experience can be logical, the experience itself is not a result of logical thought.

Psychologist and Christian theologian James Loder has considered in depth those experiences that lead to a transformation of an individual's pattern of thought or behavior.[13] He calls them "transformational moments" and has identified five steps in their progress that he calls "transformational logic." However, transformational logic is not formal logic at all, since its crux is a completely subjective leap or insight that reframes the subsequent thinking of the individual. It is similar to a Gestalt switch, in which a change of perception of the observer leads to a different observation, although the reality underlying the observation remains the same. He refutes the common idea that such moments indicate the instability of the thinker, arguing that such subjective leaps are necessary for all knowledge. In fact, he identifies an error that he names an "eikonic eclipse," in which objective intellectualization is mistaken for the entirety of achievable knowledge. With reference to the Christian theological task of understanding the nature of the Divine, in particular, he argues that the process of human transformational thought must itself be transformed by the Spirit of God before the subjective encounter with the Divine can be understood with any authenticity. Thus, for Loder, subjectivity of thought is not only inescapable, but crucial for Christian theology; no framework of thought is appropriate without the transformational logic whose impetus and basis is provided by the Spirit of the Divine itself. In his view, complete objectivity is not only unattainable, it is ultimately destructive.

Experiments in quantum physics have called into question the very notion of an objective world that exists apart from the subjectivity of the observer. A variety of authors have noted these results and have speculated on their implications.[14] For example, subatomic entities sometimes behave as waves and sometimes as particles. The act of measurement by the observer appears to be a factor by which the potential of the entities is actualized into either wave or particle. Something in the process of obtaining information at the quantum level influences the reality that is observed there. This is not objective reality as it has been described classically, static and independent of the observer. Instead, it is fluid, potential reality, its actualization depending in some sense on factors external to itself. Heisenberg's uncertainty principle, stating that the momentum and the position of any subatomic entity cannot be determined simultaneously with precision, means that subatomic particles do not simultaneously possess both an objective momentum and an objective position. Astrophysicist John Gribbin quotes Heisenberg's assessment of this situation: "We cannot know, as a matter of principle, the present in all its details." [15] At some quantum level, "objectivity" may not even exist; probability and potential appear to be the only objectifiable realities. Niels Bohr, one of the architects of quantum theory, maintained that it was meaningless to distinguish between reality and observed reality. The properties of a quantum system cannot be discussed without reference to the observer, because he or she is a part of the phenomenon described.[16]

These quantum observations have led some thinkers to discount objective reality altogether. Bohr himself, however, argued *not* that an observer creates reality, but that she or he influences reality, thereby becoming a part of what is known. The phenomenon under observation can only be known through a relational interaction with the observer.[17] In this model, the objectivity of the phenomenon intertwines with the subjectivity of the observer, and both are influenced as a result. This relationality of object and observer closely resembles some aspects of Christian theology that argue for the necessity of a relationship between human and Divine before an authentic encounter between the two can take place.

Any adequate theological method must admit that human objective, conceptual thought is limited and recognize that human subjectivity is the location of the divine-human encounter and is intimately entwined with all objective theological thought.

To summarize, the methods of science and Christian theology have a great deal in common. Subjectivity and objectivity are both necessary and interrelated in these disciplines in the following ways:

- Structured subjectivity is at the heart of both experimental science and communal worship.
- Paradigms guide both the organization and the interpretation of communal ex-

periences, and they influence experimental design, data interpretation, and theological reflection.

- Personal experiences are objectified so they can be discussed and interpreted within the community. These experiences include experimental observation, both quantifiable and nonquantifiable, as well as religious experience.

- Nonrational, transformational thought processes such as intuitive leaps or transcendent experiences are vital to both disciplines.

- A set of non-provable propositions concerning the nature of reality is foundational to each discipline. Science presupposes that the cosmos behaves in certain regular ways; religion presupposes the existence of a transcendent reality can be known.

- In quantum physics, the relationship between object and observer influences not only the observer's subjectivity, but the act of observation also influences the object that is observed. Similarly, theology affirms that deity is experienced and understood within relationship.

Contemporary Western culture has tended to establish a false dichotomy between science and religion, based on the misunderstanding that science is objective while religion is subjective. As long as this error is perpetuated, conversation between the two disciplines will be hampered. Even worse, the nature of objective propositions in both science and religion has been widely distorted. Journalists for the popular media who are writing for a wide audience frequently have no training in either science or theology. Missing the subtleties of method, they naively pronounce scientific or theological propositions to be "fact," universally applicable, and authoritative. They have thereby set up an unavoidable conflict between the two disciplines, forcing a choice between their claims, since from this perspective both cannot be right. This perspective ignores the reality that all these statements, whether scientific or religious, are limited by the bias of the observer, which is informed by the paradigms of the community within which they were formulated. Further, neither scientific nor theological statements encompass reality in its fullness, as it exists independently. As quantum observations demonstrate, the most they can do is to approach limited aspects of reality under any particular set of circumstances.

Science and religion have important contributions to make to the understanding of human identity and the nature of human interaction with the cosmos. Their perspectives are different; each discipline can offer unique answers to the questions that we ask as human beings. It is crucial that dialogue between them be facilitated so that each discipline can inform and enrich the other. Both disciplines are and should be foundational to human life. Their methods must be understood so that mutual challenge, correction, enrichment, and enhancement can take place between them. Otherwise, the false perception that one must be chosen over the other will continue to impoverish people's lives, as they are forced to ignore either their minds or their souls in the search for truth.

Works cited:

Barbour, Ian G. *Myths, Models, and Paradigms.* New York: Harper & Row, 1974.

_____. *Religion and Science.* New York: HarperCollins, 1997.

Barrow, John D. *The World Within the World.* Oxford: Oxford University Press, 1988.

Davies, Paul. *The Mind of God.* New York: Simon and Schuster, 1992.

Gribbin, John. *In Search of Schroedinger's Cat.* New York: Bantam, 1984.

Kuhn, Thomas S. *The Structure of Scientific Revolutions.* Chicago: University of Chicago Press, 1962.

Loder, James E. *The Transforming Moment.* Second edition. Colorado Springs: Helmers and Howard, 1989.

_____ and Jim W. Neidhardt. "Barth, Bohr, and Dialectic." In *Religion and Science: History, Method, Dialogue*, ed. by W. Mark Richardson and Wesley J. Wildman, 271-289. New York: Routledge, 1996.

McFague, Sallie. *Metaphorical Theology.* Philadelphia: Fortress, 1982.

Polkinghorne, John. *Science and Theology.* Minneapolis: Fortress, 1998.

The Presbyterian Church (USA). "Final Report and Recommendations to the Advisory Council on Church and Society from the Task Force on Theology and Cosmology." In *The Church and Contemporary Cosmology*, ed. by James B. Miller and Kenneth E. McCall, 385-391. Pittsburgh: Carnegie-Mellon University Press, 1990.

Root-Bernstein, Robert S. "Setting the Stage for Discovery." In *The Culture of Science*, ed. by John Hatton and Paul B. Plouffe, 328-338. New York: MacMillan, 1993

Endnotes:

1. For examples, see Barbour, *Religion and Science*; Polkinghorne; and The Presbyterian Church (USA).
2. Davies, p. 19.
3. Kuhn, *The Structure of Scientific Revolutions.*
4. Barbour, Ian G. *Myths, Models, and Paradigms*, p. 94-98.
5. Ibid., p. 95.
6. Root-Bernstein, p. 335-336.
7. Ibid., p. 338.
8. Barrow, p. 25.
9. Ibid., p. 24.
10. Ibid., p. 257.
11. Barbour, *Religion and Science*, p. 119.
12. McFague.
13. Loder, *The Transforming Moment.*
14. For example, Barbour, *Religion and Science*; Barrow; Gribbin; Polkinghorne.
15. Gribbin, p. 157.
16. Barrow, p. 148-149.
17. Loder and Neidhardt.

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"What are mortals that you are mindful of them?" A Reading of the Biblical Message about Human Being and Nature from the New Vision of Science and Ecology

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The author integrates the new scientific view of the universe with a rereading of the Genesis creation narratives. He introduces a reading of the human being as Vicar of God in light of "precomprehension" offered by science and the ecological crisis. New biblical interpretation of the unique role of humanity is compelled both by increased scientific knowledge of the cosmos and also by ecological destruction. In particular, the ecological crisis has emphasized that human domination of the world may destroy it. Interpreting Genesis from a New Testament viewpoint, particularly from the writings that announce a "new creation" performed by Jesus Christ, may remake the original mission of Vicar of God and lead Creation, affected by sin, to the new reality that it longs for.

Contemporary View of Nature as a Pre-comprehension[1] of the Biblical Message

In the contemporary context, one has to approach biblical messages regarding "nature" in light of the following fact: the contemporary view of the cosmos hardly coincides with a biblical cosmology. Contemporary biblical readings of nature vary considerably from those elaborated in the Holy Writ. One's "pre-judgment" today is very different from those of the biblical writers, because social context and exegetical methods vary throughout time. Actually, the variation in the scope of human understanding regarding nature has been so vastly increased over the past three centuries that biblical scholars and theologians have been forced to reconsider biblical assumptions regarding creation. The "Galileo Galilei case" [2] is paradigmatic of this contemporary reconsideration of the core of the biblical message and the temporality of the images where it has been transmitted. In the contemporary situation, two basic contexts need consideration: the development of science and technology, and the global ecological crisis.

A. The development of science and technology

Modern science presents an amazingly complex and varied image of the universe. The cosmos seems fathomless in both the macroscopic dimension (stars and galaxies billions of light-years away) and the microscopic one (subatomic particles and delicately balanced forces). Likewise, the life phenomenon seems to be something much older and less simple than the concept conceived by classic biology even a few decades ago. In other words, not much remains of the image of universe that humanity sustained either spontaneously or scientifically for thousands of years.

Moreover, it would also be suitable to consider the irruption of new technology. This is no longer a simple instrumental use of things—ages-old and improved through history—but a true superstructure of humanity that complements and, in many cases, replaces the tasks humans perform. Technology geometrically multiplies the potentiality of the individual, and in some extent, operates autonomously, independent of it own maker. This new reality is producing an enormous alteration of the cosmic stage where human beings live.

B. Global ecological crisis

Technological phenomena are directly linked to a new situation in Earth: the ecological crisis, involving, for example, the modification of nature's rhythms. Technology has affected all ecosystem processes. Indeed, there is no place without human impact. In the future, humanity will face a modification of climatic, physical, and biological planetary systems. One can assume that human activity will extend its effects to other planets, and in this way the evolving dynamism of human beings will invade other regions of the universe.[3]

Human beings are, then, generating a remarkable mutation in the surrounding nature. Thus, humans do not consider nature to be a fearful and amazing mystery anymore, but a truly well-documented and able-to-be-modified reality. This is the reason why there is a new view of nature and the position of humans within it. Consequently, a new understanding of the world as Creation, and the human mission in it, is compulsory. These two new hermeneutic pre-judgments have contributed to have a new reading of the biblical texts about Creation. These new readings are described in the sections that follow.

Humans do not consider nature to be a fearful and amazing mystery anymore, but a truly well-documented and able-to-be-modified reality.

Aspects of Creation in the Old and New Testaments:

A. The Hebrew Scriptures

1. The essential goodness of Creation

The two creation stories in Genesis show the same message regarding the ground and sense of the nature in two different ways. The story in Gen. 1:1-2: 4 presents Creation as having been activity developed in six days, with the seventh day devoted to the repose of the Creator. The gradual appearance of beings respects a certain ontological order: light first; water and air, second; dry earth and vegetation, third; stars, fourth; fish and birds, fifth; other animals and human beings, sixth. Human beings are, consequently, set in the universe as the culmination of Creation. A structured order is repeated daily: God spoke, and things came into existence, and God saw that they were good, and so passed one evening and morning.

Although this narration does not intend to be a phenomenological description of the creation process, it is possible to find several affirmations: God freely created the natural world, the order of nature is logical, every creature has an essential value, and humanity has preeminence over the rest of Creation.

2. The connection between nature and humanity

A second story of creation is presented in Gen. 2:4b-25. This story, attributed to the Yahwist tradition, describes the event of creation in a more anthropological and picturesque way. The main emphasis of this passage is to place humanity at the center of the creation design. The human being was modeled out of clay as a potter shapes a vase; the Creator placed humans into a garden that was specially created for them. After God created the garden and the animals, God then required humans to establish a relationship with nature by asking Adam and Eve to name and care for the animals and the garden.

3. The cosmic traces of sin

The subsequent problem of sin and its social and cosmic consequences are introduced several times in the book of Genesis. The references about the animosity between the serpent and the female, on the one hand (Gen. 3:14-16), and the resistance of the earth to the work of the male, on the other (Gen. 3:17-19), attempt to explain the new relation between human beings and the rest of the creatures after the fall of humanity. In addition, the story of the Deluge culminates with a new cosmic alliance between God and all living beings, with the rainbow as a sign (Gen. 9:8-17). These passages reflect disturbances introduced into a natural world by human beings. The narrations do not intend to explain conflict in nature, e.g., meteorological phenomena or the survival of the strongest individuals and species; rather, they show a very deep relationship between humanity and the rest of the universe. This complicated relationship includes the extension of the mystery of evil, originated in the human heart, to the natural cosmic order.

4. The human relationship to the cosmos

Psalm 8 places the human being in reference to the cosmos:

> O Lord, our Sovereign,
> how majestic is your name in all the earth!
>
> You have set your glory above the heavens.
> Out of the mouths of babes and infants
> you have founded a bulwark because of your foes,
> to silence the enemy and the avenger.
>
> When I look at your heavens, the work of your fingers,
> the moon and the stars that you have established;
> what are human beings that your are mindful of them,
> mortals that you care for them?
>
> You have made them a little lower than God,
> and crowned them with glory and honor.
> You have given them dominion over the works of your hands;
> you put all things under their feet:
> all sheep and oxen,
> and also the beasts of the field,
> the birds of the air, and the fish of the sea,
> whatever passes along the paths of the seas.
>
> O Lord, our Sovereign,
> how majestic is your name in all the earth![4]

The author of this psalm, in a spirit of admiration before the created universe, situates human beings at the center of the cosmos and endows them with monarchical powers. The question of human significance is introduced through the wonder caused by the beauty and complexity of the world: if the universe is so wonderful, human beings have to be even more amazing in order for God to place them in positions of power. Yet human power is limited. Divine providence, held by God over humanity, can be perceived through the overwhelming beauty of the natural world.

B. The New Testament

The New Testament goes deep into some of the same subjects introduced in the Hebrew Scriptures. Here, Jesus, the Christ, plays a central role in the history of the cosmos.

1. The human relationship to the cosmos

According to the New Testament, the word by which God had created everything is the eternal *Logos*. John's Gospel says that the word which God spoke to make the universe has personal and divine entity: For example, John 1:3 indicates that the word is *someone* of God, *a person* who is, on the one hand, an instrument and, on the other, God's own self that had designed and given existence to all the cosmos. Further, John 1: 14 indicates that the *Logos* is the same Son that took our flesh and lived among us. This intervention of the creator *Logos* over the world is a new introduction into the biblical text.

2. The Incarnation of the Son

The Incarnation contains implicit points about nature. The act of incarnation endows corporealty with positive attributes. In fact, incarnation confirms the essential goodness of all the creation, including the material. John's Gospel and other subsequent authors, such as Ireneus of Lyon,[5] regarded deep consequences for the different aspects of the Christian mystery. Ireneus discussed the Christian Gnostic theories, in which matter was conceived as the last level of degradation of the first principle of reality. Thus, for Christian Gnosticism, the Incarnation was not a soteriological action, but a negative event. The passion of Christ would not have been real and, thus, would have been without consequence for the whole of human life.

3. Human beings as masters of creation

The interpretation of the phrase, "human beings as masters of creation" has been the subject of a great deal of scholarly debate.[6] According to Gen. 1:26-30, God created men and women in his "image and likeness," thereby granting power over the whole creation. Humans were given the power to populate and the power to dominate creation. The second narration shows the same idea by the metaphor of taking care of the garden, although it also introduces the issue of the conflict present in it after the sin (cf., Gen. 2:4b-3:24). In the last century, some philosophers and theologians began to criticize the interpretation that the West gave of it during many centuries; they claimed that such interpretations inspired human abuse of nature. They understood that the expression "master" (*dominum*) had been used to mean "exploiter."

Contemporary ecological sensibility has moved to a new reading of the creation narrations of the Genesis texts. Biblical scholars and theologians see a contradiction between two main points in the text: the human mission as master of creation, and the destruction of Creation at the hands of humanity. In addition, they criticize some ideas historically attached to the biblical narrations such as: (1) the illuminist philosophy regarding humanity as almighty and directed toward unlimited progress; and (2) Darwinist/capitalist considerations that only the most intelligent and powerful beings will survive. These conceptions are a distortion of the biblical messages. The centrality of humans in biblical texts exists in order that they may perfect the universe, not destroy it. Yet some of the biblical mandates, such as the order that humans populate the Earth, need new interpretations. Today, individuals are consciously aware of the limitations of our planet, and they are responsible for using that knowledge wisely. It is impossible for the Earth to sustain 100 billion people; therefore, the commandment to fill the Earth must be reconsidered.

4. The New Creation

Theologians, with a more sensitive view of the environmental disturbance process, are rethinking the mission to care for the world, together with St. Paul's writing on the "new creation." In fact, in Romans 8:20-22, Paul says that Creation was wounded by original sin, and so it was introduced in a situation of slavery (vs. 21), inflicting such sufferings "as a woman in labor undergoes" (vs. 22). Nevertheless, it maintains the hope of participation in the glorious freedom of God's children (vss. 20-21). This hope is based in the presence of the Holy Spirit in those who believe. The Spirit claims to update or confirm redemption in the very bodies of believers (vs. 22). Thus, according to St. Paul, all nature hopes for fulfillment. But this hope has as framework the Incarnation of the Son and the mission of the Holy Spirit in all believers. They were made "God's children" through the death and resurrection of Christ and the interior action of the Spirit of God. In this way, they are transformed into "new creatures," "pneumatic beings," and have the spiritual ability to work for a new creation.[7]

Humans can change the despotic way of living their vocation as Creation's masters. They can accept the new forces put into their hearts by the Lord of the universe, in order to guide their abilities toward the construction of the complete Creation according to God's initial dream.

This means that humans, at least as a possibility, are able to go back to their original mission of the Hebrew Scriptures, and they have new forces to do it. There is a new situation in history and in Creation after the event of Christ: humans can change the despotic way of living their vocation as Creation's masters. They can accept the new forces put into their hearts by the Lord of the universe, in order to guide their abilities toward the construction of the complete Creation according to God's initial dream. In other words, humans can once again take on the original mission of God's Vicar, to carry the universe into its final destiny, and they have the forces to do it.

Conclusion

The Bible does not present an ecological theology, strictly speaking. It does, however, present the basis for a last consideration of nature and the sense of the whole universe after the new creation performed by Christ and updated by the Holy Spirit. It indicates that human sin enslaved nature. Nature now depends on humans, as God's Vicars, to act on behalf of creation. Such action is made possible through the incarnate God now present through the Holy Spirit. Through the power of the Spirit, nature can truly hope for a complete restoration. Humanity is tied to nature and the destiny of the natural world depends on human intervention.

Works cited:

Clifford, Richard J. "La creación en la biblia hebrea." In *Física, Filosofía y Teología. Una búsqueda común*, ed. by Robert Russell, William Stoeger, and George V. Coyne, trans. by Juan José Blásquez Ortega, Alejandro González Sánchez,and Eugenio Urritio Albisua, 195-97. México D.C.: EDAMEX, 2002 [original English edition, *Physics, Philosophy, and Theology*, ed. by J. Leslie. New York: Macmillan, 1990].

de Gennaro, Guisseppe, ed. *Il cosmo nella Bibbia*. Napoli: Edizioni Dehoniane, 1982.

Gadamer, Hans Georg. *Vom Zirkel des Verstehens*. In *Gesammelte Werke*, vol. 2. Tübingen: Mohr, 1986.

Meiss, Anneliese. "San Ireneo." In *Diccionario Teológico El Dios Cristiano*, ed. by X. Pikaza and N. Solanes, 721-26. Salamanca: Secretariado Trinitario, 1992.

Panikkar, Raimon. "Antinomias entre la cosmología moderna y las cosmologías tradicionales." In *Entwicklung zur Menschlichkeit durch Begegnung westlicher und östlicher Kultur*, vol. 1, *Schriften zur Triadik und Ontodynamik*, ed. by Heinrich Beck and Ishmael Quiles, 218ff. Frankfurt am Main: Peter Lang, 1981.

White, Lynn. "The Historical Roots of Our Environmental Crisis." *Science* 155 (1967): 1206.

Endnotes:

1. The use of the expression "pre-comprehension" is inspired by the work of Hans Georg Gadamer. According to this philosopher the reader always approaches a text with a preconceptual understanding. This idea is necessary for every act of comprehension. According to Gadamer, the interpreter approaches the texts not as if they were a *tabula rasa*, but with his or her own pre-comprehension (*Vorverständnis*), i.e., with pre-judgments (*Vorurteile*). Thus, pre-comprehension does not have a negative meaning. It is just important to remove it in order to read the text with-

out an idea that may change its essential meaning. See Gadamer.

2. When Galileo Galilei proposed the heliocentric theory, many theologians of the Roman Catholic Church reacted against him because they thought that such a theory contradicted the biblical creation narrative. See de Gennaro, pp. 54, 98.

3. See Panikkar, p. 218.

4. Altered to make the text gender-inclusive.

5. The date and place of Ireneus's birth are unknown, but he died in Lyon in 208. Cf. Meiss.

6. According to Lynn White, Christian theology established the dualism between human being and nature, but also insisted on the idea that the exploitation of nature by humans is will of God. See White, and Clifford.

7. Cf. Eph 4 and 24; Col 3 and 10.

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Biological Altruism and the Cultural-Evolutionary Roots of Religion

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The unselfish, altruistic behavior of insect societies can be explained by way of unusually close genetic relatedness, while the cooperative behavior of chimpanzee and other distantly related mammalian social groups results from their daily, social "tit-for-tat" trading of favors. These sociobiological explanations, however, are inadequate to explain altruistic behavior among human groups with members numbering in the thousands or millions, groups consisting for the most part of genetically unrelated individuals with little or no daily social contact. Religion, cultural evolutionary theory suggests, may be the glue that binds them together.

Altruism is the unselfish concern for others, especially at the expense of one's own well-being. Altruistic behavior among animals seems, however, to run counter to the theory of evolution. How could the genes for altruistic behavior be selected for and propagated down through the generations when such behavior is an expensive disadvantage to those who possess it—it *diminishes* their chances of survival, their fitness? William Hamilton resolved this dilemma with his concept of "inclusive fitness." From a gene's point of view, Hamilton suggested, what counts is being propagated down through the generations, not who specifically does the propagation.[1] Parents, obviously, share genes with their offspring, and one can see how it might pay, from an evolutionary viewpoint, for parents to aid their children's survival, even at the expense of their own, at times. Stories of parents—particularly mothers—sacrificing their lives to save their children are legendary. What is not so obvious is that sacrificial or altruistic behavior benefiting a sister, cousin, or other relative could, under the right circumstances, also be evolutionarily advantageous, and therefore preferentially selected generation after generation. Ants, for instance, are noted for their sacrificial altruistic behavior in the numerous wars between their colonies.

The workers in ant colonies, sisters all, are unusually closely related to each other and to their mother queen due to a quirk in the ant's reproductive process.[2] Helping their mother reproduce is, from a selfish genetic viewpoint, more advantageous than having their own offspring. As a result, worker ants do not produce their own offspring, as a rule. They pass their genes along indirectly by helping—in concert with thousands or millions of other sister-workers—their mother pass along her genes. The entire group as a "superorganism" is being selected by genetic evolutionary forces. So, which ant groups are being selected? and which fall by the evolutionary wayside?

The key to ant evolutionary success is group size. When it comes to all-out warfare, the larger group usually wins. It is a matter of simple attrition arithmetic. The slaughter ends when one of the two warring groups has been totally decimated. Even with losses about equal on both sides, it is the larger group that still has more live ants in the end, and they march unopposed into the loser's nest to haul off their war booty.

But to work together so effectively as a group, ants need group identification. Lacking flags, they achieve group solidarity chemically: each ant colony has a different "smell." To be effective in war, ants need to bring thousands of warriors quickly into battle, and individual ants must be genetically programmed to lay down their lives for the greater good of the group in defense of the mother queen. Ant colonies with such altruistic genes survive (are selected) at the expense of those that lack such genes. Although close genetic relatedness and group selection via large-scale warfare may explain altruistic behavior among the social insects, it does not explain altruism among groups of animals, such as baboon troops, which include family groups and also outside individuals unrelated to the others. Why should these animals, often unrelated, go out of their way to help each other?

To understand this behavior, a form of altruism has been proposed, often termed "tit-for-tat." I may help you (even if you are not genetically related to me) if I feel confident that you will return my favor in the future. When I have extra food and you are short, I will give you some of mine; but I will expect you to return the favor when the situation is reversed. Tit-for-tat requires keeping track of who owes favors to whom, as well as the relative size of the favors. Tit-for-tat can be a beneficial system for all concerned, but the system of favors breaks down if cheaters (who accept favors but do not return them) are allowed to flourish. Thus, they must be punished and, in severe cases, banned.

Monkeys and apes might have evolved unusually large brains for their body size because such brains are required to keep track of the many tit-for-tat deals in their large social groups. Such intelligence has been labeled Machiavellian, and resembles human politics in its complexity, as suggested by the title of Frans de Waal's book, *Chimpanzee Politics: Power and Sex Among Apes.*[3]

Biological altruism, resulting from either genetic relatedness or tit-for-tat behavior, is the basis of animal social behavior and forms the heart of the field of sociobiology, launched by Edward O. Wilson, the noted myrmecologist (ant scientist) at Harvard, in the mid-1970s. In *The Insect Societies*, he considered sociality across the societies of ants, bees, termites, and social wasps, looking for commonalities and differences. Having one of those minds that insist on firmly placing his own specialty within the context of the next higher level, Wilson saw no reason to stop with the sociality of insects, so proceeded onward and upward to consider sociality across all life. He named his broad look "sociobiology."[4]

However, as had numerous biologists before him, Wilson ran into difficulties when he extended his biological reasoning to that most troublesome of species, *Homo sapiens*. Specifically, Wilson thought his sociobiology could and should serve as the basis for a new human sociology, a suggestion few sociologists accepted, because sociobiology does not really explain large-group behavior among humans. For, in contrast to the closely related societies of insects, there is little genetic relatedness in large-scale human societies. Furthermore, while humans do have unusually large brains for their physical size, they are not, computers or ledgers aside, able to keep track, in a tit-for-tat sense, of the many favors that individuals might owe them.

So how is the recent urban guise, from an evolutionary perspective, to be explained? How, via the forces and course of evolution, could such a phenomenon have arisen? How could an obscure primate have evolved in just a few thousand years from a planet-wide population of two or three million hunter-gatherers to ultra-social, ant-like, highly organized groups now numbering in the billions? What had sociobiology overlooked?

The answer lies in a theoretical difficulty with Wilson's sociobiology: he failed to distinguish between medium-scale social groupings such as wolf packs, and large-scale, ultra-social animal societies such as ant colonies, termite nests, and human urban societies. Donald Campbell overcame this difficulty with the concept of "ultrasociality," which he suggested occurred in both large-scale insect societies and human urban societies.[5] Such societies are now often termed "superorganisms."[6] Campbell suggested that while both insect and human superorganisms had evolved as groups rather than as individuals, the difference between them was that insect superorganisms had evolved by way of genetic selection rules, while human urban societies had evolved by way of cultural selection rules.[7] Although genetic evolutionary theory and cultural evolutionary theory share many similarities, there are also fundamental differences in how these two evolutionary mechanisms operate, differences first noted by Charles Darwin in *The Descent of Man*[8] and, more recently, by Robert Boyd and Peter Richerson.[9]

When I have extra food and you are short, I will give you some of mine; but I will expect you to return the favor when the situation is reversed. Tit-for-tat requires keeping track of who owes favors to whom, as well as the relative size of the favors.

The distinction between genetic and cultural evolution is critical. As long as *Homo sapiens* and their hominid ancestors existed in small groups, comparable in size to those of thier closest relatives, the chimpanzees, then their behavior was explicable through sociobiological (genetic) reasoning by way of inclusive fitness (genetic relatedness) and tit-for-tat social trading. However, as discussed above, such sociobiological reasoning is ineffective when it comes to explaining human large-group behavior, i.e. groups numbering in the thousands or even millions—groups which sprang into existence in just a few thousand years. Genetic evolution is quite slow in humans, occurring over timescales of tens of thousands of years or more, which makes it difficult to see how civilizations could have resulted from genetic evolution. Furthermore, there is considerable genetic diffusion between human groups. Genetic group selection does not operate as effectively with human groups as it does with ant colonies, because the winning group usually absorbs the losing group—genes and all. Although hominid altruism, presumably, was initially sociobiologically based, i.e., similar to their chimpanzee relatives, at some point in hominid evolution cultural evolutionary selection rules must have become dominant over genetic evolutionary selection rules. When did cultural group selection begin shaping the species in the direction of human superorganisms?

The archeological record suggests that, starting some 40,000 years ago, human groups began symbolically distinguishing themselves, one group from another, via decorations. Such group-distinguishing identification was a necessary prerequisite to effective cultural group selection, marking off what was being selected. For cultural evolution to operate effectively, there also had to be a group selection mechanism. Among humans, as is the case with ants, this mechanism was group warfare. Contrary to the myth of the "peaceful savage," war existed well before the earliest civilizations.[10] When a culturally-identified group was defeated at war, its genes continued on, but its identity, its existence as a cultural group, was often lost. Successful cultural groups, on the other hand, grew by absorbing unsuccessful groups. They occasionally split into two groups (fission reproduction), and their cultural stories and beliefs (proto-religions) spread by way of cultural conquest.

With cultural group identification, selection, and reproduction in place, *cultural* evolution (as opposed to *genetic* evolution) quickly came to dominate the evolution of the human species. The result should come as no surprise: large, well-organized, and well-armed groups with good internal cooperation survived and grew. The members and genes of the losing group were incorporated within the larger, winning groups, but the cultural ways of the losers, their weaker myths, their less altruistic proto-religions were not. Thus, there were strong cultural evolutionary pressures for increased group size and close internal cooperation.[11] The direction cultural evolution took is clear: larger groups were better.

Hunter-gatherers spread out over tens of thousands of square miles could not form large, cohesive groups; but with the advent of agriculture, truly large, concentrated groups became possible. Cultural evolution rapidly searched for, found, and strengthened those cultural features that enhanced cooperation within such large groups. These groups, numbering in the tens of thousands, were of necessity composed primarily of unrelated individuals. Holding such groups of unrelated individuals together by way of coercion is both difficult and inefficient. What was needed was a moral code, an organized religion that would bind members together with common myths and a shared worldview. Altruistic behavior could then emerge, even though group members were unrelated and could not expect direct tit-for-tat returns. But how could such groups avoid accumulating cheaters who accepted the benefits of group membership but failed to contribute? What these early moral codes needed for enforcement, according to Kevin Sharpe, is a deity.

For a code of morality to work, it needs an extra kick that other motivations lack. The additional power arises by a natural process in which believers project the morality onto a deity (the All Powerful).

For a code of morality to work, it needs an extra kick that other motivations lack. The additional power arises by a natural process in which believers project the morality onto a deity (the All-Powerful). Group members, then, believe in an independent and objective moral code that is changeless and independent of human conditions. It emanates from something higher than and outside of themselves. Feeling this absolute moral "other" as a force acting upon them, they follow its moral dictates. They believe their deity requires it of them, and they strive to obey it.[12]

The notion of the Divine is cleverness itself. It is, perhaps, the greatest all-time discovery of cultural evolution in its effort to enable ant-like human superorganisms without the necessity of excessive coercion. Ants, if they had larger brains, would fully appreciate the Golden Rule to treat others in your group, stranger or not, as you treat yourself. That is exactly what ants do.

Michael Ruse and Edward Wilson have described morality as "an illusion fobbed off on us by our genes to get us to cooperate.... It's a shared illusion of the human race." [13] They miss the boat: It is human culture, not human genes, that have evolved to compensate for a total lack of genetic preparedness for living in groups numbered in the millions. Cultural evolution, fueled by the cohesive power of religion, has rocketed the human species to planetary dominance in only ten thousand years. By contrast it took genetic evolution some fifty million years to bring ants to their dominant position in the insect world. Having devised a unique style of altruism, humans have evolved into a "crude superorganism," [14] becoming the "chimpanzees who would be ants." [15] Ants may have their fine-tuned superorganism genes, but we've got religion!

Works cited:

Boyd, Robert, and Peter J. Richerson. *Culture and the Evolutionary Process.* Chicago: University of Chicago Press, 1985.

Byrne, Richard. *The Thinking Ape: Evolutionary Origins of Intelligence.* Oxford: Oxford University Press, 1995.

Campbell, Donald T. "The Two Distinct Routes Beyond Kin Selection to Ultrasociality." In *The Nature of Prosocial Development*, ed. by Diane Bridgeman. New York: Academic Press, 1983.

Corballis, Michael C. and Stephen E. G. Lea. *The Descent of Mind: Psychological Perspectives on Hominid Evolution.* Oxford: Oxford University Press, 1999.

Darwin, Charles Robert. *The Descent of Man.* 1871. Reprint of Darwin's 2nd ed. New York: Prometheus Books, 1998.

Dunbar, Robin. *Grooming, Gossip, and the Evolution of Language.* Cambridge: Harvard University Press, 1996.

Genet, Russell M. *The Chimpanzees Who Would Be Ants: The Evolutionary Epic of Humanity.* Huntington, N.Y.: Nova Science, 1998.

Hamilton, W. D. "The Evolution of Social Behavior." *Journal of Theoretical Biology* (1964) 7:1-52.

Keeley, Lawrence H. *War Before Civilization: The Myth of the Peaceful Savage.* New York: Oxford University Press, 1996.

Parker, Sue Taylor, and Michael L. McKinney. *Origins of Intelligence: The Evolution of Cognitive Development in Monkeys, Apes, and Humans.* Baltimore: Johns Hopkins University Press, 1999.

Richerson, Peter J., and Robert Boyd. "The Evolution of Human Ultra-Sociality." In *Ideology, Warfare, and Indoctrinability*, ed. by I. Eibl-Eibisfeldt and F. Salter. New York: Berghahn Press, 1999.

Sharpe, Kevin. *Sleuthing the Divine: The Nexus of Science and Spirit.* Minneapolis: Fortress Press, 2000.

Sober, Elliott, and David Sloan Wilson. *Unto Others: The Evolution and Psychology of Unselfish Behavior.* Cambridge, Mass.: Harvard University Press, 1998.

de Waal, Frans. *Chimpanzee Politics: Power and Sex Among Apes.* London: Jonathan Cape, 1982.

Wilson, Edward O. *The Insect Societies.* Cambridge, Mass.: Harvard University Press, 1971.

_______. *Sociobiology.* Abridged ed. Cambridge, Mass.: Harvard University Press, 1975.

Wright, Robert. *Nonzero: The Logic of Human Destiny.* New York: Pantheon, 2000.

Endnotes:

1. See Hamilton's classic paper.

2. Haplodiploidy.

3. For support of the social brain hypothesis, see Byrne, Dunbar, Parker and McKinney; and Corballis and Lea. For chimpanzee politics, see de Waal.

4. Wilson's *Sociobiology* is a classic. I prefer the abridged edition.

5. Campbell's concept of ultrasociality overcame the difficulty with E. O. Wilsons's rather broad categorization of the more social animals.

6. Although the concept of urban humanity as insect-like superorganisms is an old one, its modern revival is primarily due to Campbell. Recent expansions of Campbell's concept include those by Genet, Richerson and Boyd, and Wright.

7. The concept of cultural group selection and its controversial history is treated at length by Sober and Wilson.

8. Although Darwin's launching of biological evolution is well known, his initiation of the study of cultural evolution is less well known and lay fallow for over a century.

9. The modern revival of cultural evolutionary theory has been spearheaded by Robert Boyd and Peter Richerson.

10. The "myth of the peaceful savage" has been shown to be incorrect through anthropological research. See Keeley.

11. Sober and Wilson.

12. Sharpe, p. 127.

13. As quoted in Sharpe, p. 134.

14. The characterization of humanity as a "crude superorganism" is taken from Richerson and Boyd.

15. The conceptialization of humanity as the "chimpanzees who would be ants" is my own. See Genet.

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Understanding Morality in the Religion-and-Science Context

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Recent developments in biotechnology require re/definition of human "being." In this paper, the author suggest that the term "human being" is substituted with "human betweenness." This substitution emerges from a philosophical/theological reading of biological texts, such as those by E. O. Wilson, Ernst Mayr, Richard Lewontin, and David Slan Wilson. The betweenness is possible only by the bodily integration (i.e., inclusive fitness or causal efficacy). Yet the need of the integration already presumes the complexity and overlap of the betweennesses (reciprical altruism or presentational immediacy). The Confucian understanding of morality as the integration of Tao *(道 the Way) and* Te *(德 Virtue) shows the possibility of seeing human "being" as human "betweenness,"—that is, human "being" as the actualization of plural* li (理) *in the bodiliness (氣).*

Introductory Reflection

My experiences of the xenotransplantation lab placement seminar and the "religion-and-science" class have offered me a new perspective to see the world differently than before. The experience of the xenotransplantation lab brought me a moral/ethical confusion from the lack of moral/ethical criteria for directly judging bioethical dilemmas and problems. The class in religion and science has offered me how the current science, that is, biology, has explored human morality and its social nature. Together, the class and the lab placement have led me to think about human moral sense and about how religion and philosophy explain it. Although looking at cognitive science and bioethics have really been helpful for me, I do not mention them because they lie outside the scope of this paper.

Xenotransplantion shows a vision of a human beings hybridized with cells or organs derived from pigs. It is a vision in which the human being seems to become an immortal being, who would be able to extend life until she or he wants to die, by continuously replacing old and worn-out cells and organs with new ones. It would be the fulfillment of the longest-held wish of human beings: to be immortal or to be divine, by manipulating the natural processes of life. At first, it seemed so, at least to me. In other words, xenotransplantation seems just to repeat the myth of human beings as "the masters of all creation." when our global community does not have a "reverence for all life."[1]

In fact, there have also been some negative perspectives of xenotransplantation. According to those perspectives, in short, xenotransplantation is the violation of "a line that should not be crossed" because it will just intensify a desire to increase financial interest.[2] In other words, commercial cross-species transplantation, including xenotransplantation, would just lure into "huge financial incentives for biotechnology and pharmaceutical companies."[3] The cost of xenotransplantation is expected to outweigh the benefit it promises to offer ($250,000 per operation in 1995).[4] In this sense, xenotransplantation is just for the chosen.[5]

Further, there is no evidence that researchers have overcome the infection problems derived from xenosis. There are ample evidences in the history of medicine that the crossing over of species boundaries can cause fatal medical disasters.[6] In the case of xenotransplantation, there are currently no ways "to screen for all animal-specific diseases" and to avoid "a lethal unknown virus" that can escape our vaccination and testing programs.[7] Worse, no way to predict the possible results from xenotransplantation with regard to its long-term negative effects. Further, according to the report of the Institute of Medicine in June 1996, it is not possible to biotechnologically produce "germ-free" (or pathogen-free) animals.[8]

Moreover, even if researchers can organize a regulatory system to monitor the recipients of xenotransplantation and his/her family and intimates and to prevent the spread of unknown disease, there is no guarantee for it because "weak regulatory oversight, and human error and negligence" cannot be completely eliminated.[9] Given our society's poor ability to manage "the consequences of modern science and technology, including the increasing lethality of military weapons, environmental pollution, rainforest destruction, exponential population growth, and AIDS," we cannot honestly but ask ourselves "whether we have the wisdom and moral maturity needed to deal with the consequences of xenotransplantation and related genetic technologies."[10]

Selfish motives cannot forever be eliminated from human nature; but, according to this multilevel selection theory, humans can increase altruistic motives voluntarily, so as to increase the fitness of the group.

Macroscopically, the above problems are not confined to xenotransplantation. Rather, any human development of sciece and technology more or less accompany some of them. All human activities including xenotransplantation have caused probably by our inborn biological drives. In this sense, science and technology can be seen as the expression of our deliberate action (有爲 *yu-wei*). The deliberate action (有爲 *yu-wei*) includes the re-formation of our naturality artificially.[11] That is, our deliberate action (有爲 *yu-wei*) as well as the action of non-action (無爲 *wu-wei*) also belong to our naturalness of life. In this sense, we cannot simply reject the biotechnology. If it is worth enough to improve our life situation, we need to think positively about it.[12] For example, the treatment of Parkinson's Disease by xenotransplant technology would contribute to the well-being of the global community. No disease is an individual matter. In a family, when one member gets sick, it at least influences everyone else in the family. In this sense, the benefit of treating a disease is communal.

The real problem is the fact that human beings are not good enough to build a relevant moral virtue for handling the emerging problems from the new scientific/medical technologies. Moreover, they do not have any objective criterion to evaluate the virtue of each person. Although the concept of virtue can offer an orientation towards a solution, it does not offer any details. In this context, religiosity needs to have a more practical perspective toward problematic situations. This is the real problem I see when I look at the matter of xenotransplantation. Can a relevant moral framework be built in order to discuss human actions (有爲 *yu-wei*) and wisdom (無爲 *wu-wei*). Again, the current problem seems to lie in a "lack of a moral framework" to "form moral integrity."[13] Although the above negative judgment on xenotransplantation, on the one hand, and science and technology in general, on the other hand, raises many questions, all the questions seem to summarize in the following two questions: Who are we? and what is the limit of human activity (manipulation)? These are the questions of the moral integration. These are what religions have tried to answer throughout their histories. Traditionally, the religious forms of the two questions are: Why is there something rather than nothing? and, Is everything possible if God does not exist? Can the possible religious answers to these questions bring us a practical ethical option to solve the current moral dilemma caused by the rapid development of sciences and biotechnologies?

These days, some biologists seem to answer these questions.[14] However, their answers seem to be very antagonistic to religion and philosophy. Moreover, their definition of religion seems to be very strange to me. For instance, the conservative and narrow spirituality of the Southern Baptists, against which E. O. Wilson himself stands, is a very tiny part of all the religions in the world. Furthermore, their answers do not seem to say anything new, because the biologists' discoveries about morality are things that many of world's religions have always emphasized. However, it does not mean that religion gives any clear answer to the problems or that science cannot produce a solution. Rather, a way of consilience across the boundary between science and religion needs to be found. From a unified wisdom in human activities, some practical options for the future can be devised.

Nevertheless, we theologians need to keep in mind that, when religions lose a flexibility to see actual situations, they are going to face a threat of disappearing. This is the futuric vision Wilsonian sociobiology offers,[15] and theologian Willem Drees recommends that religions—including theologians and philosophers—take science seriously.[16]

Biological Explanation of Morality

Biologist Ernst Mayr tries to distinguish the ultimate causation from the proximate causation in explaining morality and ethics.[17] His explanation of morality and ethics is based on the distinction between *inclusive fitness altruism* and *reciprocal altruism*.[18] Mayr's explanation offers a chance to distinguish morality from ethics on the basis of the distinction between inclusive fitness and reciprocal altruism. By doing so, Mayr tries to avoid a kind of biological reductionism, a biology-based systematic analysis of social and cultural phenomena. Mayr's understanding of the origin of human ethics emphasizes the importance of learning. That is, inclusive fitness is a small part in human ethics. Rather, the inborn tendency should be developed by learning. Thus, the role of culture is emphasized more than inborn genetic mechanism, although the latter is the basis of the former.

By contrast, Wilson's concern[19] lies in making a tight junction between genes and cultures, thus making biology predictive science. For Wilson, sociobiology is "the systematic study of the biological basis of all social behavior."[20] This has led other scientists and humanists to see Wilson's sociobiology as a program of strongly reducing all social behaviors, including cultures, to biological or genetic mechanisms. In fact, Wilson's methodological reductionism is to make science predictive, because, for Wilson, the value or meaning of science lies in its "predictive power," not in its "true description."[21] Thus, by understanding the biology of human inborn genetic mechanism, the future can be influenced on the basis of scientific prediction about the workings of the genetic mechanism. That is, the understanding of the inborn (genetic) tendency for inclusive fitness should be more emphasized; the understanding of inclusive fitness is prior to learning and should be the basis of learning, because learning is carried out on the basis of the predictability of inborn tendencies for inclusive fitness.

However, for Lewontin, "God is in details, that is, good science is based on carefully established facts, not on ambitious models."[22] For Lewontin, there is no way to make any science predictive.[23] It would end in making scientific theories into mixtures with social and political ideologies. Rather, focusing the facts known thus far, we should try to ease the difficulties of contemporary life situations, such as overwork and low wages, according to whatever we perceive of as environment. For Lewontin, the role of science is to describe accurately the real world with its complexity and multilayeredness. The live complexity of reality should not be reduced in order to make a theory that describes it. Any theory that disregards the complex aspects of reality is "bad science."[24] Thus, for

Lewontin, the Wilsonian project of sociobiology belongs to the category of bad science, in that it seeks the predictability of human social behaviors.

For the multilevel selectionists, Elliott Sober and David Slan Wilson,[25] the basic mechanism of altruism is inclusive fitness. Reciprocal altruism may be a secondary mechanism. To increase the fitness of group, the secondary mechanism intensifies the altruistic motives and behaviors in the primary genetic mechanism of an individual in the group. In this process, there are no singular, but only plural, motives in human moral behavior. Selfish motives cannot forever be eliminated from human nature; but, according to this multilevel selection theory, humans can increase altruistic motives voluntarily, so as to increase the fitness of the group, the inflated self that sets up a boundary between the Other (identified with "my"-self) and the other (abjected as "someone-else-self"). Moreover, this group selection process can take place both on the genetic and cultural levels. Although this multilevel selection theory does not show the tight connection between genes and culture, the secondary mechanism can increase the frequency of altruistic behavior by complementing the primary biological mechanism through social structures, laws, moral imperatives, and so on. Thus, this multilevel selection theory shows a rough picture of the interaction between genes and cultures; and, in my view, this picture is very much closer to the Wilsonian project than to Mayr and to Lewontin, in that genes and culture are really interconnected with each other.

All of the biological theories exclude any religious and philosophical explanation from their understanding of morality and ethic. All of them think that no religious explanation is any longer needed to explain the meaning of life and the justification for morality. For theologians and philosophers or humanists, these arguments sound very strange, because what the biologists think of as religion seems to be incredibly narrow, and also because what the biologists have discovered as "new" about morality and meaning of life does not seem to be anything new. Biological theories do not take theology and religion (and philosophy) seriously enough.

Nevertheless, the scientific explanations of morality are sufficiently clear to allow a rough picture to be drawn about interconnections between genes and culture, and the relation between body and mind. This picture seems to offer a starting point for the integration of religion and science. In Whitehead, this interconnection between genes and culture, between body and mind, is expressed as "causal efficacy"; and in Confucian thought, it is expressed as the unification of body and mind through moral self-cultivation. The causal efficacy matches with the interconnection of genes and culture, and moral self-cultivation seems to be a religious contrast to volitional evolution, especially in E. O. Wilson's thought.

Philosophical and Religious Explanations of Morality in Terms of Human Bodiliness and Betweenness

All these biological explanations are centering on the "causal efficacy" or "human bodiliness" of morality. We humans are biological beings. Our cultural architectures may be historical extensions of our biological mechanism.

None of the above biological explanations of morality allows theology or philosophy to offer wisdom for the future of human beings. For example, Wilson has a certain moral aim that is "a quantitative explanation of all aspects of human social behavior [to be] able to formulate a trajectory of mankind's future (as a substitute for divine prophecy)."[26] Thus, his moral task is to exclude "the divine spirit and other extraneous agents" from the explanation of human nature and also to explain divine revelation in terms of the "quantitative explanation," because Wilson thinks that both theology and Western philosophy are currently unable to offer the needed wisdom for the future of humankind.[27] By doing so, Wilson puts science at a position of importance higher than the humanities and social sciences, exaggerating that only science "prescribes the correct values for us."[28] Mayr shares, at least in part, the same spirit. His explanation of morality and ethics never offers even a tiny space for religion and theology. In Lewontin's framework of gene-organism-environment interaction, there is no need for seeking anything transcendental. What we have to do is back to our ordinariness to solve the prohlems on the basis of the existing established facts.

Religious morality has for a long time emphasized the importance of moral self-cultivation through learning and study and the improvement of moral propensity through the bodily practice of morality.

Here, the theologian cannot but ask: Does biological science do a sufficient job in explaining morality? Is this kind of biological explanation of morality really new? Is it fair to say that theology and philosophy have lost their power to offer wisdom for humanity? From the perspectives of theology and philosophy, the thing that is "in the details" is actually the devil, not God.[29] If science is to be taken seriously, then the same seriousness ought to be paid to religion, theology, and philosophy.

In this paper, the philosophical and religions explanations of morality that I take are centered on ordinary human life. Philosophical explanation focuses on the bodily aspect of human life, emphasizing creativity. Religious explanation mainly deals with the transcendental, trying to figure out how the transcendental intrudes into our ordinary life. Both philosophical and religious explanations are seen as two sides of the same coin.

Both the philosophical and the religious explanations show that moral integrity is the result of inborn tendencies combined with learning.[30] Indeed, for religion and philosophy, religious morality has for a long time emphasized the importance of moral self-cultivation through learning and study and the improvement of moral propensity through the bodily practice of morality. Thus, for Confucianism, morality has always been a matter of knowing *Tao* (道) and of practicing it by accumulating *Te* (德 moral energy to flow out).

The moralistic interpretation of whitehead's philosophy of organism

In Whitehead's philosophy of organism, morality heavily depends on the feelings of the subject-superject.[31] In the process of the subject-superject, the actual entity decides what it is itself "in virtue of its feelings."[32] It is the decision of its future relevance.[33] The selection or decision of an actual entity in term of its feelings is understood by "our notion of moral responsibility."[34] The process as a selection is required by "the depths of life."[35]

On the one hand, morality in life lies in the facts that "life is robbery" and that "the robber requires justification."[36] In this context, life is "a characteristic of 'empty space.'"[37] Thus, morality is a response to "a certain social deficiency," which always exists between living beings.[38] On the other hand, the fact of evil ultimately lies in the fact that time is "a perpetual perishing."[39] It means that the process in time unavoidably accompanies with selection. Thus, selection is "at once the measure of evil, and the process of its evasion."[40] By this selection, the actual entity completes its objectification. Thus, the whole process of an actual entity is the process of admission and elimination for future relevance. In this sense, the decision of an actual entity is "a decision referent beyond itself," one anticipating its objective immortality.[41] In this sense, morality lies in a decision for future relevance, and it is the process of passing on creativity. This image of creativity offers the image of human beings as responsible decision-makers and, thus, as a co-creators; and this image of co-creator provides a very common motive for developing an overall moral framework in an age of biotechnology.[42] My religious vision of human "betweenness" puts a question mark on this image of human beings as co-creators.

For Whitehead, morality is basically a response to biological and cultural past inheritance. Nevertheless, the moral decision of an actual occasion cooperates with the initial aim from God's primordial nature. The transmutation of causal efficacy into presentational immediacy means this cooperation of the actual occasion with God's initial aim. From this perspective, inborn tendency and learning both belong to the category of causal efficacy. It is the cooperation with the initial aim that transmutates causal efficacy into presentational immediacy. In other words, the concrescence of an actual occasion is wider than that of open behavior program or epigenetic rules. Nevertheless, it is not just a "developmental noise" at the level of molecules, because the initial aim is guidance for the actual occasion and because it comes from the awareness of the whole cosmic process—simply put, from God. In a sense, Lewontin is right in that the interaction between genes and environment does not completely explain reality; but neither does the developmental noise completely explain the concrescence of the actual occasion.

This image of co-creator provides a very common motive for developing an overall moral framework in an age of biotechnology. My religious vision of human "betweenness" puts a question mark on this image of human beings as co-creators.

Confucian interpretation of morality in terms of human betweenness

Humans live in every unified eventuation of "bodiliness" and "betweenness." Human bodiliness roughly means that all human activities are based on their bodies. Human activity always seems to have its "oughtness", whose origin is not clear for the present.[43] Human activity is an intersected occasional unification of the bodiliness and the oughtness, and this unity consists of human relations. If a certain behavior is detached from its life situation, the question of the oughtness never comes up. Conversely, because a person is always in life situation, he or she cannot escape the question of oughtness. This oughtness comes to us through the betweenness. There are you and I. Between you and me, there is nothing if we think we do not have any relationship. However, even in this case, there is a relationship between us, because both of us are human beings. Thus, between you and me, there is the betweenness of human being, which seems to require at least propriety for the category of human being.[44] In most cases, the betweenness relation is mistakenly seen as a singular or monolithic state between two persons. However, human relations between two people are more complex, because my relation with you consists, for example, of the between-professor-and-student relationship, the between-White-middle-class-and-Yellow-lower-class relationship, the between-Christian-sister-and-brother relationship, and so on. Each relationship is termed "betweenness," because it describes the relational space-between-people. In this framework, relationality or interpersonality is a very huge complex consisting of many betweennesses that impose the oughtness of each relation on the related persons.

All the biologists mentioned in this paper agree that genes, organism, and environment are all interacting. The organism integrates the biology of the body and culture by the open behavior program or by epigenetic rules, or it just functions as the "developmental noise" on the level of molecules. A consensus among these biologists is that morality is the combined development of inborn tendencies and learning. Even in Lewontin, the developmental noise, which produces organismal variations, is formed as neural connections during development. The formation of the connection may seem to be a random process from the perspective of a determinist, but it is formed by an inborn mechanism and its transmutation of environmental signals into molecular signals. It does not preclude a possibility that the environmental signals include signals formed by learning. The contentions between the biologists concern whether the interaction can be regulated voluntarily by human interventions and whether the interventions can be done in a predictive way.

The answers of Whitehead and Confucianism are: microscopically, "No" to both of the questions; but macroscopically, "Yes" to both. The exact pathway of the transmutation of causal efficacy into presentational immediacy cannot be determined. Also, there is no universal principle to integrate all the *li* (理 betweenness[es]) within *chi* (氣 bodiliness). Always, the integration of *li* and *chi* into human mind is highly context-sensitive.[45] Nevertheless, the human mind can discern the initial aim among its causal efficacy and presentational immediacy. The ability to discern it or to have *jen* (仁 humanity) is very likely an inborn mechanism called "moral sprout" by Mencius.[46] It should be developed by learning.[47] Whether the interference of the inborn moral tendency by learning can be genetically stored and transmitted to the next generation is totally a scientific question, but at least on the level of culture, it is surely transmitted.[48] It is the reason many of human societies have had an ideal of moral society. Thus, Wilsonian vision of volitional evolution is at the discretion of later scientific discoveries. However, his reasonless antagonism against religion and his insistence of the replacement of religion with the evolutionary epic are unfortunately very quick-tempered. Here is my contention: Is the initial aim explained well by the biological explanations? Even Wilson sees the role of the initial aim, which is the divine (or sublime) vision of humanity. The volitional evolution has been carried out in terms of human vision of the Great Whole.[49] The evolutionary epic does not add anything to this religious vision, nor can it replace the vision as the guiding hand of human voluntary evolution.

A Religious and Philosophical Response to Biological Morality

When morality is seen as "connected to the genes responsible for the human essence," it is in fact "nothing but a self-serving for survival," because it is anyhow to increase the fitness of an individual as a provenance of auto-affection or a group as the extended identification of the "I" in terms of self-sameness.[50] It may be a mere variation of hedonism, according to which the ultimate desires are after all "the desires to obtain pleasure and avoid pain." [51] Egoism leads the ultimate goals, whether consciously or unconsciously, to a "self-directed" one.[52] However, we know that we sometimes act altruistically, although we are never absolutely and always altruistic. What really matters here is how we can increase the frequency of the operation of altruistic motives in our lives. How do we make our motives other-directed? Although Wilson says that it is possible by knowing biology, it is an ever-impossible project to make people other-directed or altruistic by any artificial instrumental means. It is a matter of self moral integrity through moral self-cultivation.[53] It is the matter of knowing the transcendental amid the affairs of life—not the transcendental into the other world, but that into this world. How do we know it? Here lies awe in front of mystery in our walking on the Way (道 *Tao*).

Achieving self moral integrity is the matter of discerning the initial aim of God's primordial nature by an actual occasion within the range of causal efficacy and presentational immediacy. Eternal objects show God's mind, although God's initial aim is always changing as we actual occasions are always changing. Although Lewontin thinks that it is impossible to make biology predictive, it is possible for us to get wisdom for the future in the interaction between actual occasions, causal efficacy, presentational immediacy, and the initial aim. What we can get is not predictive information but wisdom that is shown to us as the initial aim. Achieving the self moral integrity also is the matter of getting *Te* (德 virtue). *Te* is the integration of the countless *li* (理) in the bodiliness (氣), and by doing so, it makes all the people beneficial because *Te* flows naturally out of the person and influences others, encouraging them to follow *Tao*.

All of our motives are probably biological, because inclusive fitness is the ultimate goal of all the organisms. However, this inclusive fitness is maintained by secondary behaviors—at least, in human cultures. In human societies, reciprocal altruism is more prominent, as Mayr sees. It is not surprising that almost all religions have emphasized the communality of human beings. Although Confucianism expresses the reason for moral integrity in the realm of the sublime, it never sought for integrity itself. Without actualizing in ordinary, complex, human relationality, anything called *Tao* is not *Tao*. Although Wilson believes that religions and their sacred mythologies can be replaced by "the epic of evolution," the Sociobiology project just shows how we can increase our fitness for the future. It is Wilson's idea of volitional evolution and predictive science; that is, his vision of volitional evolution involves the increase of inclusive fitness as an extension of fundamentally egoistic motives, regardless of individual or of group. However, the genuinely altruistic motive emerges from a level different from inclusive fitness, as Mayr mentions.

Nevertheless, theologians must take science seriously.[54] Theologians need to accept that science literacy is very important.[55] Indeed, methodological reductionism should not be confused with metaphysics of reductionism.[56] We theologians also analyze things. The real truth, God, is beyond our determinateness. God is the indeterminate.[57] Truth, indeed, is unnamable. In order to see Truth, we are analyzing it and reducing it in the form of value. A simple (theological or philosophical) resistance against reductionism, whether methodological or metaphysical, does not help theologians to criticize science. A good criticism should always recognize advantages and disadvantages at the same time and be balanced. In this sense, one needs to remember that bodily self-cultivation includes study of things. We need to be informed of science. Without enough information and knowledge, wisdom does not come to us. Thus, Chu Hsi emphasized the importance of the investigation of things and the reflection on them.[58]

Also, we need to be sensitive to the context. *Tao* does not exist without the common affair. To keep concentrating on my personal and ordinary matter will disclose the mind of *Tao*. It does not end in my private enlightenment because personality already abides in the betweennesses. In this interconnected living, we need to discern the "constant mean."[59] In fact, in a society where a fact and its utility are not clearly separated but rather intimately connected, a mere statement of fact is "never really a 'mere' statement of fact."[60] That is, scientific truth is "not dependent on particular individuals," but rather "the criterion of truth is a *communal* one."[61] In this situation, one clear possibility of preventing the misuse of science for political ideology is "to keep the public better informed."[62] The uncritical close tie of our moral judgment to the latest scientific knowledge will just reinforce our unconscious (social or political) ideologies.[63] In this sense, "a moral/political debate around the potential implications of science may be the only possible way to go."[64] It will make science healthier.[65]

Back to ordinary life

Moral integrity exists in our ordinary life, neither only in our genes nor only in our environment, nor only on the level of molecules. Morality is the matter of the integration of all the level of life in ordinary life situations. It is the unification of Heaven, Earth, and human mind in human ordinary life. All the pathways of causal efficacy cooperate in this unification. In ordinary life, Heaven's mind is manifested in our betweenized pattern of relations through our moral courage. This can be seen as the creative unification of God's creative act and human mind through the Creator-created determination.[66]

Indeed, ordinary life is the scene of bioethics.[67] Without referring to ordinary life, our oughtness seems to be groundless. This oughtness arises when I look at the face of the other. The relationship between my/self and the other is betweenized, for example, through the husband-wife pattern. What I ought to do in this betweenness is very context-sensitive. There is no universal principle or norm for the action. However, I feel humanity (仁) in the betweenness. In this ordinary life, moral integration is a very long process, maybe a life-long one. We may fail. Nevertheless, I wander amid wonder.[68] This awe in ordinary life cannot be reduced to mere developmental noise.

Also, one needs bear in mind that human hands are hidden behind all the activity of human beings, including scientific activity.[69] These hidden hands should be brought to visibility into ordinary life for all to see. They should be visible to the eyes of others because there is humanity abiding in the hands. The unity of humanity and the hands is the ideal of moral integrity (知行合一). When knowledge and action are united as humanity (仁) in human mind, everything is permitted, because God (or Heaven and Earth) is there. The locus of the transcendental God is ordinary human life. The investigation of things (study and learning) leads us closer to God.

Works cited:

Berthrong, John H. *Concerning Creativity: A Comparison of Chu His, Whitehead, and Neville.* Albany, NY: State University of New York Press, 1998.

Berger, Alan H. "Xenotransplantation: Animals as Spare Parts." Internet document, 12 October 1996: <www.api4animals.org/doc.asp?ID=577>.

Brooke, John, and Geoffrey Cantor. *Reconstructing Nature: The Engagement of Science and Religion.* Edinburgh: T&T Clark, 1998.

Chapman, Audrey R. *Unprecedented Choices: Religious Ethics at the Frontiers of Genetic Science.* Minneapolis: Fortress Press, 1999.

Drees, Willem B. *Religion, Science and Naturalism.* New York: Cambridge University Press, 1996.

Fingarette, Herbert. *Confucius: The Secular as Sacred.* Prospect Heights, Ill.: Waveland Press, 1972.

Fung, Yu-Lan. *The Spirit of Chinese Philosophy.* Trans. by E. R. Hughes. Boston: Beacon Press, 1962.

Haraway, Donna. "Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective" in *Feminism and Science*. ed. by Evelyn Fox Keller and Helen E. Longino, 249-63. New York: Oxford University Press, 1998.

Ivanhoe, Philip J. *Confucian Moral Self Cultivation.* Second edition. Indianapolis: Hackett Publishing Company, 2000.

Lewontin, Richard. *The Triple Helix: Gene, Organism, and Environment.* Cambridge, Mass.: Harvard University Press, 2000.

Mayr, Ernst. *This Is Biology: The Science of the Living World.* Cambridge, Mass.: The Belknap Press of Harvard University Press, 1997.

McKenny, Gerald P. *To Relieve the Human Condition: Bioethics, Technology, and the Body.* Albany: State University of New York Press, 1997.

Medical Research Modernization Committee. "Of Pigs, Primates, and Plagues: A Layperson's Guide to the Problems with

Animal-to-Human Organ Transplants." Internet document, 1999: <http://www.mrmcmed.org/pigs.html>.

Neville, Robert Cummings. *God the Creator: On the Transcendence and Presence of God*. Republished. Albany: State University of New York Press, 1992.

Reiss, Michael, and Roger Straughan. *Improving Nature?: the Science and Ethics of Genetic Engineering*. New York: Cambridge University Press, 1996.

Segerstrale, Ullica. *Defenders of the Truth: The Battle for Science in the Sociobiology Debate and Beyond*. New York: Oxford University Press, 2000.

Sober, Elliott, and David Slan Wilson. *Unto Others: The Evolution and Psychology of Unselfish Behavior.* Cambridge, Mass.: Harvard University Press, 1999.

Thomasma, David C., and Thomasine Kushner. *Birth to Death: Science and Bioethics*. New York: Cambridge University Press, 1996.

Turning Point Project. "Where Will the Next Plague Come From?" Internet document, 1999: <http://www.turnpoint.org/geneng.html>.

Varela, Francisco J., Evan Thompson, and Eleanor Rosch. *The Embodied Mind: Cognitive Science and Human Experience*. Cambridge, Mass.: the MIT Press, 1993.

Whitehead, Alfred North. *Adventures of Ideas*. New York: The Free Press, 1933.

_____. *Process and Reality*. Corrected Edition. Ed. by David Ray Griffin and Donald W. Sherburne. New York: The Free Press, 1978.

_____. *Science and the Modern World*. New York: The Free Press, 1925.

Wildman, Wesley J. "The Use and Abuse of Biotechnology: A Modified Natural-Law Approach." *American Journal of Theology & Philosophy*. 20:2 (May1999).

Wilson, Edward O. *On Human Nature*. Cambridge, Mass.: Harvard University Press, 1978.

_____. *Consilience: The Unity of Knowledge*. New York: Vintage Books, 1998.

Endnotes:

1. Berger, pp. 3-4.

2. Turning Point Project, p. 1.

3. Medical Research Modernization Committee, para. 1. See also Turning Point Project, p. 2; and Berger, p. 2.

4. Berger, p. 2.

5. Ibid.

6. Turning Point Project, p. 1.

7. Berger, p. 3; Medical Research Modernization Committee, para. 8.

8. Medical Research Modernization Committee, para. 10; Berger, p. 3; Turning Point Project, p. 2.

9. Medical Research Modernization Committee, para. 11.

10. Medical Research Modernization Committee, para. 15.

11. Ivanhoe, pp. 32-33.

12. Cf. Wildman, p. 173.

13. Reiss and Straughan, p. 6; McKenny, p. 5.

14. Mayr; Wilson, *Consilience*, p. 265 .

15. Wilson, *Concilience*.

16. Drees.

17. Mayr.

18. According to Ernst Mayr, inclusive fitness altruism is based on the basic instrict like "defense of the offspring by the mother or the father" (Mayr, p. 251). Although this type of altruistic behavior is apparently seen as altruistic, it is in fact egoistic "from the point of view of the genotype," because this type of behavior, after all, contributes to the passing on of the genotype in question (Mayr, p. 252). Reciprocal altruism, according to Mayr, can simply mean "a mutually beneficial interaction among unrelated individuals" (Mayr, p. 253). This type of behavior shows the transition from innate moral to ethics in human behavior. Yet the importance of morality derives from the innatedness, the givenness, of desire to integrate. Thus, simple contrast between primitive moral (inclusive fitness) and advanced ethic (reciprocal altruism) does not work.

19. Wilson, op cit.
20. Segerstrale, p. 26.
21. Ibid., p. 260.
22. Ibid., p. 40.
23. Lewonton.
24. Segerstrale, p. 40.
25. Sober and Wilson.
26. Segerstrale, p. 40.
27. Ibid., pp. 159, 351-52; Wilson, p. 269.
28. Segerstrale, p. 363.
29. Wildman, p. 169.
30. A combination of causal efficacy and presentational immediacy in Whitehead, Confucius, Mencius.
31. Whitehead, *Process and Reality*, p. 222.
32. Ibid.
33. Ibid., p. 27.
34. Ibid., pp. 222, 255.
35. Ibid., p. 340.
36. Ibid., p. 105.
37. Ibid.
38. Ibid.
39. Ibid., p. 340.
40. Ibid.
41. Ibid., p. 60.
42. Cf. Wildman.
43. Fingarette.
44. Ibid.
45. Fung; Ivanhoe.
46. Ivanhow, p. 18.
47. Ivanhoe.
48. Sober and Wilson.
49. Fung.
50. Sergestrale, p. 397.
51. Sober and Wilson, p. 224.
52. Ibid.
53. Fung; Ivanhoe; Fingarette.
54. Drees, p. xi.
55. Chapman, p. 3.
56. Segerstrale, p. 285.
57. Neville.
58. Ivanhoe, pp. 50-51.
59. Fung.
60. Segerstrale, p. 375.
61. Ibid., p. 385.
62. Ibid., p. 389.
63. Ibid.
64. Ibid., p. 390.
65. Ibid., p. 408.
66. Neville.
67. Thomasma and Kushner, pp. 1-2.
68. Drees.
69. Brooke and Cantor, p. 5.

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The Paradox of the Self and its Implications for Concepts of Personhood: Contrasting Contemporary Theological and Psychological Approaches to an Old Problem

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It is a widely accepted principle in both theology and the human sciences that the self, though each person perceives him- or herself as a singularity, is also characterized by multiplicity. The author analyzes this apparent paradox as it appears in contemporary social cognitive psychology and in Christian theological models of the person that are grounded in the doctrine of imago Dei. *He argues that, whereas there are evident differences in the psychological and theological conceptions of the nature of persons, both disciplines endorse concepts of personhood that are characterized by a dynamic process of self-unification. Thus, the conceptual divide alleged to exist between theological and secular scientific models of the person may not be as pronounced as many suppose.*

Introduction

A paradox lies at the heart of this essay. Although persons perceive themselves to be whole, seemingly unified, continuous singularities, both contemporary psychology and Christian theology seem to accept that what has come to be referred to as the self is, at best, multifaceted and, at worst, fragmented. As with so many issues relating to the study of the human self, it is a paradox with an ancient pedigree. Allusions to the multiplicity of the person are readily identifiable in historical and contemporary philosophy and theology and are especially prominent in twentieth-century psychology.

It is commonly supposed that theological conceptions of the self are at odds with scientific conceptions. In mainstream secular psychological science, at least, contemporary metaphors for mind and self have largely replaced traditional concepts inspired by Christian theology. Evocative terms such as "soul," "spirit," and "essence" have given way to a mundanely anatomical language that frames the modern cognitive self against the background of "memory stores," "modality-specific mental modules," and "patterns of distributed neuronal activation." Less pointed, even, than the "id" and "ego" of Freudian psychoanalysis, these have proved to be immensely important concepts that have yielded a great deal of insight into the functioning of the individual, but seem far removed from everyday experience. The conceptual specificity and value-neutrality that is, purportedly, inherent in modern psychology is a welcome development in the search for a fuller understanding of the real inner person; but there is still, arguably, a need for theories that capture the elusive not-readily-quantifiable aspects of the sense of self as it is actually experienced. It is just these facets of the person that have been elaborately described in the writings of countless philosophers and theologians; and, though these are often portrayed as outdated, overly value-laden or irrelevant to current psychological theorizing, psychologists should not dismiss this body of theories too quickly.

It is not just psychology and the secular philosophy of mind that has overlooked the importance of a dialogue with theology. Orthodox Christian theologian John Zizioulas notes:

> The attempt to supplant Christianity in whatever concerns the dignity of man has succeeded in detaching the concept of the person from theology and uniting it with the idea of an autonomous morality or with an existential philosophy which is purely humanistic. Thus, although the person and "personal identity" are widely discussed nowadays as a supreme ideal, nobody seems to recognise that *historically* as well as *existentially* the concept of the person is indissolubly bound up with theology.... The person both as a concept and as a living reality is purely the product of patristic thought. Without this, the deepest meaning or personhood can neither be grasped nor justified.[1]

He is not alone in holding this opinion.[2]

There are, certainly, differences between Christian theological and psychological approaches to the self, foremost of which is the theological attestation that true personal wholeness can be attained only through "salvation.[3] The doctrine of *imago Dei* seems to have crucially important implications for this concept. Since humankind is created in the image of the triune God, in whom inheres a perfect unity of Persons, overcoming estrangement from God through salvation and thereby becoming a member of the kingdom of God would seem to entail the essential unity of the person. Secular psychology, at first glance, does not seem to hold the goal of self-unity in such high esteem. However, it is possible, I believe, to delineate certain similarities in their respective approaches to personhood and the assumed multiplicity of the self that underlies it. There may be, therefore, considerably more common ground than many are prepared to acknowledge.

Here at the beginning, I wish to clarify the typology that I will employ throughout this essay, since the terms "person," "self," and "identity," have become somewhat confused in recent times.[4] "Person" is the most overarching of these terms, and denotes the sum total of the component parts of any human individual, including the physical body, the mind, the sense of self and identity.[5] "Self," to adopt Rom Harré's definition, will "...do duty for the many aspects of personal being that appear in personal and private regard."[6] "Identity" will here be taken to refer to those public and private aspects of the way an individual person conceives him- or herself and is conceived, in relation to other persons and the physical world.[7]

Below, I shall contrast social cognitive psychological theories of human individuality with those contemporary theological approaches that are grounded in the doctrine of *imago Dei*. I will first establish that both disciplines conceive persons to be physically embodied individuals-in-relation, in which multiple senses of self inhere.[8] I will then argue that both disciplines identify personhood with a dynamic process of self-unification, and, thus, they exhibit a degree of similarity in their respective solutions to the paradox of the self.

The Disunity of the Self in Psychology and Theology

It is a fundamental tenet of much of contemporary psychology that a multiplicity of self underlies the individual person. In modern psychology this idea first arises in the work of William James, who divided the concept of the whole self into "I-component" (the "pure ego") and "me-component" (the "empirical self").[9] James further subdivided the "empirical self" into three constituent parts, which he claimed were organised hierarchically—the spiritual self at the top, the (plural) social self in the middle, and the material or bodily self at the bottom.[10] James also believed that the "I" of the self represented the "active agent," able to shape its own destiny, and is, therefore, better conceived as a process, or verb, than as an entity. This contrasts with the empirical self, portrayed as the subjective interpretations of the individual's experiences.

For James, multiplicity and perceived social self-evaluation go hand in hand, hence his famous observation that a person could be considered to have "...as many social selves as there are individuals who recognise him and carry an image of him in their mind."[11] This idea was elaborated upon in the theories of the symbolic interactionists, Charles Cooley and George Herbert Mead, and continues to form the basis of the vast majority of contemporary social psychological models of the self.[12] According to these theorists, the self is better described as a multiplicity, developed through the subjective interpretation of the reactions of others in a social context, and continually reconstructed on the basis of new social experience.[13]

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An "I/me" distinction remains prevalent in contemporary writings, though James's concepts of the pure ego and empirical self have not weathered as well. The "I" of modern psychology, which refers to the "self-as-knower," or the "experiencing subject," is contrasted with the "me," meaning self-as-known, or the object of experience; and the two are usually portrayed as co-existent and co-determining.[14] As George Herbert Mead observed, "If the "I" speaks, the "me" hears. If the "I" strikes, the "me" feels the blow." [15]

In the last fifty years, cognitive psychology, which has its theoretical foundations in, and draws its conceptual inspiration from, a computer metaphor for mind, has initiated a new era in research on self. Social psychologist H. R. Markus has argued that the self is more accurately described as a collection of interrelated "self-schemata," each of which organizes and encodes specific information regarding perceived personal knowledge or interpersonal relationships. Schemata are, roughly speaking, structured clusters of concepts relating to one's knowledge of stereotypical situations; they are well-established entities in cognitive psychology. According to this model, multiple conceptions of self exist, not all of which are available at any one time. Markus prefers to emphasize "working," "on-line," or "accessible" self-concepts, whereby the self is a dynamic and pluralistic structure that remains continually active and in perpetual flux.

Each of these theories of self is compatible with the conceptual typology outlined above. So, how well do these secular psychological approaches to the human subject correspond to those of contemporary Christian theology? Certainly, there is an ancient Christian theological tradition of conceiving the person as a multifaceted entity. Augustine's theology of the soul, for example, presents several different ways in which this might be expressed. Each person, he alleges, is constituted by matter and spirit, characterized by both "outer" and "inner" aspects; and each soul is constituted by many different levels of being, each "struggling" for dominance over the others.[16] In each case, the multiplicity of the person is appealed to in order to explain the continuity of humankind with the rest of creation, but also to distinguish it and to explain its unique standing in relation to God. Such prominent philosophers and theologians as Søren Kierkegaard, Emmanuel Levinas, Paul Ricoeur, and Paul Tillich have each, at some point, discussed the finite fragmented existence of the person in relation to the infinite unity of God. Disunity, it seems, is everywhere.

However, perhaps the most fruitful strand of contemporary theological thought to acknowledge the various multiple facets of the self can be identified in discussions of the *imago Dei*, and it is primarily this body of theories that I shall contrast with contemporary psychological thinking about the person. Clearly, the interrelationships of the three Persons of the Trinity and the implications of this for the *imago Dei* have frequently been addressed in attempts to understand human persons. Sometimes, it has been assumed that humanity as a whole bears the image of the "social" Trinity (for example, in the work of Jürgen Moltmann), but many have attempted to understand the *imago Dei* in as much as it relates to the single, autonomous, multifaceted individual. I wish to focus on here on this latter perspective. Protestant theologian Alasdair McFadyen's book, *Christian Theory of the Individual in Social Relationships*, is exemplary of such an approach, though many have contributed to this general enterprise.[17]

Beginning with the presupposition that, "Individuality, Personhood and selfhood do not...refer to some internal and independent source of identity, but to the way one is and has been in relation," McFadyen argues:

> [H]uman being is determined by the relational form proper to it, which may be materially defined as being-in-gratitude. This in turn implies that the relational structure of human being is one of openness to and for God's Word.[18]

McFadyen's purpose here is to establish the dialogical nature of the divine-human relationship and the response of the person to God as a "free-dialogue partner" in the context of this relationship.

> [T]he divine image, and the freedom associated with it, are not qualities or attributes which we can possess in ourselves; rather, they designate a way of being in relation.[19]

Conceiving the nature of God as Trinity, McFadyen proposes an analogous theory of individual being. He argues that the model of the Trinity as a unique community of Persons does not entail the autonomous individuality of each Person, nor an understanding of each Person as a specific mode of relation to the other Persons of the Trinity. Instead, he proposes that the Trinity subsists as "Persons in relation and Persons only through relation. Persons exist only as they exist for others, not merely as they exist in and for themselves."[20] This perspective is reflected in his understanding of *human* persons as acquiring identity through their relations with others. Persons are individuals constructed through their interpersonal relations with each other and with God. He supposes that at any given moment a person can be located at a spatio-temporal point in a grid or network comprising the relationships that are central to his or her social world. At any particular time, then, the location of the person is determinative of the identity of that person at that time. Changing location entails changing identity:

> To enter a particular communication at a particular point in a given exchange is to make an implicit claim concerning the social validity of such a contribution.... The social space and time it is appropriate for "me" to occupy in each case is different.[21]

Although some elements of this theory are similar to some of those secular psychological theories discussed above, the grounding of McFadyen's theory in the *imago Dei* leads to a distinctive difference—the core themes of relationality and multifaceted identity, which McFadyen believes define the person, are grounded in the image of God as it inheres in the human. Where psychology sees a two-way, mutually determining relationship between an individual and the others of society, McFadyen's theological anthropology sees a triune relationship between individuals, society, and God.

Even from this brief overview, then, emerges a general consensus between some contemporary secular psychologists and Christian theologians that physically embodied persons have multiple senses of self, which are formed largely through their experience of interpersonal interaction. However, I now wish to show that neither secular psychology nor Christian theology necessarily dismisses the idea of a substantive, enduring component to the individual. Far from it. Rather, the multiplicity of selves can be ascribed specific content in as much as it can be represented as real knowledge about the person, even if this knowledge is derived and distilled from social encounters—in which case, personhood itself is best conceived, perhaps, as something substantive beings *do*, rather than as a fixed unchanging state of being. From this perspective, the substantive individual cannot be separated from his or her being-in-relation. This is, as will be seen, a widely endorsed principle.[22]

Personhood as the Unification of Self: Identity in Psychology

Returning for a moment to Harré's concept of self, he writes:

> The self as an expression of the singularity of the point of view of the embodied person in perception, the unity and structured pattern of the contents of consciousness, is always singular for every human being, in all cultures. I f there are exceptions they are in the realm of myth and mysticism.[23]

By this, he means that every person uses the personal pronoun "I" in such a way that individual people can somehow claim their experiences for themselves and index them as events in their own personal history. How, exactly, should this assertion be squared with the tacit acknowledgement that the self is ultimately a plurality? I shall argue here, that this depends on precisely how self-unity is conceived.

There is no singular universally agreed upon conception of self-unity.[24] One of the best-established approaches to this problem, however, and arguably the most successful, is to adopt a phenomenological approach to self-unity, as psychologist and philosopher Dan McAdams does, and seek to understand it through the description of how one derives one's *sense* of self.[25] Several types of theory have been proposed in this mold. Some, notably the cogitive psychologist Seymour Epstein, propose that the self is analogous to an hypothetico-deductive theory of how one relates to the world, and that the unification of the self is promoted by one's natural drive toward internal consistency.[26] Others suppose that a person's various selves are structurally interconnected so as to form a loosely integrated whole, giving the illusion of unity, but continuing to exist as a multiplicity, each retaining the capacity for a degree of autonomous functioning. This, in Marvin Minsky's terms, is the "society of mind." [27] It is similar to the preferred approaches of psychologists Seymour Rosenberg and Francisco Varela.[28]

There is, however, a common denominator to almost *all* accounts of self-unity: unity is not a static *property* of the self; rather there is a dynamic *process* of self-organization at work.[29] Considering self-unity in dynamic terms, rather than as an attribute of a superordinate *entity*, also offers an extremely congenial theory of personal individuality and uniqueness, which avoids the problems of absolute relativism. Individuality, from this perspective, subsists in the unique *organizational pattern* of a person's multiple selves. McAdams's approach is possibly the best developed, most systematic theory of this kind.[30]

> ***Sometimes, it has been assumed that humanity as a whole bears the image of the "social" Trinity, but many have attempted to understand the* imago Dei *in as much as it relates to the single, autonomous, multifaceted individual.***

McAdams discusses the "I-self," in process terms as "selfing." Remaining faithful to the Jamesian concept of the 'I' as the "process of being a self," McAdams defines the verb "to self":

> To self—or to maintain the "stance" of an "I" in the world—is to apprehend and appropriate experience as a subject, to grasp phenomenal experience as one's own, as belonging "to me." [31]

Central to this concept of the "I-self" is that the process of experiencing one's material and social world changes the "me" in some way, which, in turn, exerts a significant influence on how one's material and social world is experienced. In James's terms, "the 'I' reflexively creates a modern 'me' for which the 'I' assumes authorship and responsibility."[32] McAdams explains"

> [T]he "me" is a motley collection of self-attributions.... For many adults in contemporary modern societies, unity in the "me" is rather a cultural expectation that arises when one seeks to move from a self-list [such as myself as a father, myself as a friend, etc.]...to a more patterned and purposeful integration of the "me."[33]

This purposeful integration, he argues, takes the form of the construction of a narrative to one's life story. Unity in the 'me', then, is also the construction of identity.

Such a narrative synthesizes the synchronic and diachronic elements of the "me" into a coherent unified whole, so that one's experience of "me"in the past leads to the "me" of the present, which in turn sets the stage for the "me" of the future.[34] A great many theorists are in complete agreement with McAdams, that this is indeed how one's life is given unity and purpose.[35] Importantly, it is a continuous process, which never culminates in the "birth" of a person. Rather, personhood is a perpetually evolving process of becoming. Theologian Emmanuel Levinas remarks:

> The "I" is not a being that always remains the same, but is the being whose existence consists in identifying itself, in recovering its identity throughout all that happens to it. It is the primal identity, the primordial work of identification.[36]

It seems that even if a person's multiple selves are not necessarily unified in any sense other than the purely phenomenological, this is in itself enough to endow a sense of unique individuality and continuity.[37] The process of self-unification *is* the process of becoming a person. It is the process of organizing experience into a unique pattern — an autobiography, or the narrative of an individual life story. It is essentially the construction of identity.[38]

Personhood as Becoming a Being in Relation: Theological Concepts of Individuality

I now turn to examine the potential similarities between secular psychological notions of self-unification and a specific concept of personhood that has developed within Christian theology. I argue that personhood can also be portrayed, from a theological perspective, as a process that involves both unifying the multifaceted senses of self and maintaining a degree of consistency. However, these senses of self are ultimately grounded in a faith relationship with God.

Continuity and stability, as McFadyen and Vernon White use the terms, have their equivalent in the concept of wholeness, or singularity, which Harré and others identify as a definitive characteristic of the human person. Protestant theologian Wolfhart Pannenberg argues:

> The wholeness of the self, which infinitely transcends the limitations of life at any given moment, finds its present manifestation as personality. "Person" signifies the human being in its wholeness, which transcends the fragmentariness of its reality-at-hand.[39]

Persons, he presumes, are more than just collections of fragments; they are characterized by a unified and continuous experience.[40] In fact, theological expressions of the importance of personal wholeness are not difficult to find.[41]

Theologically, the unity or continuity of the self has exceedingly important implications (in contrast to secular psychological theories), both with respect to personal ontology and to personal responsibility. Given the essential unity of the persons of the Trinity, to be created in the image of God means to be created as a whole, unified person, not as a multiplicity of distinct selves. Without an essential continuity of identity, moreover, how could an individual be strictly said to be in relation to God at all, since within the one body, many independent relationships would be established. As Anglican theologian Vernon White simply observes, "The originality and uniqueness of each individual is a presupposition of Christian belief of our createdness, and of prophetic ministry." [42]

The projects of White, Colin Gunton, and John Zizioulas to ground the individuality of human persons in a systematic theological ontology is also, in many ways, an attempt to defend the unity of the person, and thereby establish the continuity of identity. They wish to establish the existence of a substantive component to human persons—a consistency that underpins the many identities brought into being through the continuous flux of relationality that is implied by understanding persons as beings-in-relation. Without this continuity, they argue, "the self is always likely to be...unstable, transient, diminished." [43]

White criticizes philosophical theologian John Millbank for the kind of extreme relativism that he and McFadyen strive to avoid. Millbank argues:

> Just as God...is not a "substance," because he is nothing fundamental underlying anything else, so also there are no substances in creation, no underlying matter, and no discrete and inviolable "things".... There are no things, no substances, only shifting relations.[44]

What is attractive in this account is its description of the dynamism of personhood. According to Millbank, personhood *is* the constant flux of relationality, not just a fixed state of being. For White, Millbank takes a step too far, as this concept of personhood removes any possibility of conceiving persons as "enduring particulars" or of establishing a continuity in personal identity. For both White and McFadyen, persons "are a manifestation of their relations, formed through though not simply reducible to them." [45]

McFadyen, also wary of the Millbankian extremes of relativism, offers a defense of this idea of "relational but particular personhood." He argues:

> The "I" which responds in the flux of unfolding situations and relationships includes a 'sedimentation' of previous such moments of response which together form a unique and stable cluster within the structure of the developing personal identity.[46]

Personal identities are somehow "sedimented" from personal experiences of social relations and are, therefore, bound to the identities of others and one's relations with them. Part of being in relation, then, is the construction of identity—a product of the "I" acting to unify the "me."

Where psychology sees a two-way, mutually determining relationship between an individual and the others of society, McFadyen's theological anthropology sees a triune relationship between individuals, society, and God.

McFadyen posits the existence of what he refers to as, a "deep-self," which is not subject to the same degree of changeability that a person's other multiple identities are susceptible to. The deep-self is seen as a core aspect of identity, which is derived from the sedimentation of the experience of a particularly close relationship, and which is always present in the background of one's relations with less significant others. Unlike other identities, it is not situation specific. Effectively, it acts as a mediating presence in less stable relations, offering continuity when the sense of self is in danger of being fragmented.

Borrowing Tillich's terminology, McFadyen argues that persons, through the meaningful social expression of themselves, come to "center" themselves. His concept of "centering" is very closely analogous to the organizational processes that many secular psychological theories have described and leads to the person experiencing him- or herself as directing communication from a continuous point of identity. Hence, persons, through the recognition and understanding of the fact that they are unique socially interactive *individuals*, are able to form an experientially transcendent sense of self, which "enables one's experience and activity in diverse places and times to be unified in a central organisational structure which transcends the embodiment in any and all particular contexts." [47] It is in this way, according to McFadyen, that the individual achieves unity and continuity.

So, it appears that a number of theologians are happy to posit the existence of a stable sense of self, which is the product of prior experience, and exists over and above the relational aspects from which the individual person is formed. Thus, it is possible to discern a notion of personhood that is, in many ways, similar to the process of narratization that secular psychologists have described. A theological approach to the self is not incompatible with the idea that a person's identity exists primarily in a dialogical relation with the other of any individual relation and is, thus, specific to that relation; but for many theologians, as for many psychologists, the experience of self has a transcendent quality. Personhood involves the continuous "updating" of the person in the light of new experience; and, thus, the self must be conceived in dynamic terms. In other words, personhood is a process of becoming, a process of unification through which continuity is established, which both emerges from and is inseparable from the organized substantive center of personal experience.

In summary, I quote McFadyen once more:

> The "self" should not be conceived of as an organ, but in terms of the organization which believing in it enables. For it is not something one has but something one is and does, a way of being in public and private. It is not a substance but a means of organizing one's experience, thought, knowledge, beliefs, action, etc., as though centered on a substantial inner core.[48]

Conclusions

My primary aim throughout has been to establish certain points of contact between theological and psychological approaches to the problem of how the self comes to be unified in the human person. I have argued that secular psychological and some Christian theological theories are in broad agreement regarding the essential multiplicity of selves that underlie the person. Personhood, it is clear, is not conceived by either discipline to be a static state, and the disciplines are united in their supposition that the perceived singularity of the human person is an ongoing dynamic *process* of becoming.

Some differences have also been identified here, the most striking of which concerns the idea of personal relationality. Christian theologians, in contrast to secular psychologists, though they too recognize the importance of other *human* relationships, are specifically concerned to ground the process of becoming and the construction of identity in the notion of being-in-relation to God—as answering God's call. A further difference lies in the value ascribed to the continuity and unity of the person. No *a priori* reason exists for why the multiple selves of the person should be unified. The theories of Varela, Minsky and Rosenberg are examples of theories that are perfectly at ease with the idea that a person's selves ultimately remain disunited in anything but the most perfunctory of ways—that is, through their being parts of a single individual person. Christian theology, by contrast, emphasises the importance of the unity of the person as an essential aspect of being created in the image of, and standing in relation to, God.

Although the two disciplines have not been shown to be in complete agreement, this was neither an objective nor an aspiration. I have merely tried to show that in as much as they both address the multiplicity and unity of the self as deep and enduring problems, they can ask similar questions and make similar theoretical distinctions. Too frequently, theology and the human sciences are supposed to offer competing, rather than complementary, explanations of the self; blindly placing them in such opposition precludes the mutual elucidation that might arise from a close analysis of their subtle differences, as well as their similarities.

Pannenberg notes:

> The idea of wholeness cannot be claimed as the special preserve of theology, although theology may insist that human beings can attain their wholeness only in the form of "salvation" that is promised and given by God, and not through any effort at self-realization.[49]

The concept of attaining wholeness through salvation is indeed central to Christian theology, but it would be a mistake to presume that the idea of multiplicity is the special preserve of psychology.

Works cited:

Ashmore, Richard D., and Lee Jussim, eds. *Self and Identity: Fundamental Issues.* New York: Oxford University Press, 1997.

Augustine of Hippo. *De Trinitate.*

Baldwin, James M. *Social and Ethical Interpretations in Mental Development.* 2nd ed. New York: Arno Press,1973 [1897].

Blasi, A. "Identity and the development of the self." In *Self, Ego, and Identity: Integrative Approaches*, ed. by Daniel K. Lapsley and F. Clark Power. New York: Springer-Verlag, 1988.

Bracken, Bruce A., ed. *Handbook of Self-Concept.* New York: John Wiley & Sons, 1996.

Calvin, John. *Institutes of the Christian Religion*, ed. by John T. McNeill, trans. by Ford L. Battles. Philadelphia: The Westminster Press, 1960.

Comblin, Joseph. *Retrieving the Human: A Christian Anthropology.* New York: Orbis Books, 1990.

Cooley, Charles H. *Human Nature and the Social Order.* New York: Scribner's, 1902.

Epstein, Seymour. "The self-concept revisited: Or a theory of a theory." *American Psychologist* 28 (1973):404-16.

Eysenck, Michael W., and Mark T. Keane, eds. *Cognitive Psychology: A Student's Handbook.* Hillsdale, N.J.: Lawrence Erlbaum, 1990.

Gergen, Kenneth J. *The Saturated Self: Dilemmas of Identity in Modern Life.* New York: Basic Books, 1991.

Gunton, Colin E. "Trinity, Ontology and Anthropology: Towards a Renewal of the Doctrine of the *Imago Dei.*" In *Persons, Divine and Human: King's College Essays in Theological Anthropology*, ed. by Christoph Schwöbel and Colin E. Gunton, 47-65. Edinburgh: T. & T. Clark, 1991.

Harré, Rom. *The Singular Self: An Introduction to the Psychology of Personhood.* London: Sage Publications, 1998.

Harter, Susan. "Historical Roots of Contemporary Issues Involving Self-Concept." In *Handbook of the Concept of Self-Concept*, ed. by Bruce A. Bracken, 1-37. New York: John Wiley & Sons, 1996.

Hermans, Hubert J. M., and H. J. G. Kempen. *The Dialogical Self.* New York: Academic Press, 1993.

Higgins, E. Tony. "Self-discrepancy: A Theory Relating Self and Affect." *Psychological Review* 94 (1987): 319-40.

Horne, Brian L. "Person as Confession: Augustine of Hippo." In *Persons, Divine and Human: King's College Essays in Theological Anthropology*, ed. by Christoph Schwöbel and Colin E. Gunton, 65-74. Edinburgh: T. & T. Clark, 1991.

James, William. *Principles of Psychology.* London: Macmillan, 1890.

_____. *The Varieties of Religious Experience: A Study of Human Nature.* New York: Longmans, Green & Co., 1902.

Kierkegaard, Søren. *Fear and Trembling with Repetition*, ed. and trans. by Howard V. Hong and Edna H. Hong. Princeton: Princeton University Press, 1983.

Levinas, Emmanuel. *Totality and Infinity.* Pittsburgh: Duquesne University Press, 1969.

Lifton, Robert J. *The Protean Self.* New York: Basic Books, 1973.

Markus, Hazel R. "Self-Schemata and Processing Information about the Self." *Journal of Personality and Social Psychology* 35 (1997): 63-78.

McAdams, Dan P. "The Case for Unity in the (Post)Modern Self: A Modest Proposal." In *Self and Identity: Fundamental Issues*, ed. by Richard D. Ashmore and Lee Jussim, 46-79. New York: Oxford University Press, 1997.

McFadyen, Alistair I. *The Call to Personhood: A Christian Theory of the Individual in Social Relationships.* Cambridge: Cambridge University Press, 1990.

McGrath, Alister E. *Christian Theology: An Introduction.* 2nd ed. Oxford: Blackwell, 1998.

Mead, George Herbert. "The Social Self." In *Selected Writings: George Herbert Mead*, ed. by A.J. Reck. Chicago: University of Chicago Press, 1981.

Millbank, John. *Theology and Social Theory.* Oxford: Basil Blackwell, 1990.

Minsky, Marvin. *The Society of Mind.* New York: Simon and Schuster, 1986.

Oyserman, Daphne, and Hazel R. Markus. "The Sociocultural Self." In *Psychological Perspectives on the Self* (vol.4), ed. by Jerry Suls, 187-220. Hillsdale, N.J.: Lawrence Erlbaum, 1993.

Pannenberg, Wolhart. *Anthropology in Theological Perspective.* Trans. by Matthew J. O'Connell. Edinburgh: T. & T. Clark, 1985.

Polkinghorne, John C. *Science and Creation: The Search for Understanding.* London: SPCK, 1988.

Pfuetze, Paul E. *Self, Society and Existence.* New York: Greenwood Press, 1975.

Proudfoot, Wayne. *God and the Self: Three Types of Philosophy of Religion.* London: Associated University Presses, 1976.

Rahner, Karl. *Foundations of the Christian Faith: An Introduction to the Idea of Christianity.* London: Darton, Longman and Todd, 1976.

Rosenberg, Seymour. "Multiplicity of Selves." In *Self and Identity: Fundamental Issues*, ed. by Richard D. Ashmore and Lee Jussim, 23-36. New York: Oxford University Press, 1997.

Rosenberg, Seymour, and Michael A. Gara. "The multiplicity of personal identity." In *Review of Personality and Social Psychology* (vol. 6), ed. by Philip Shaver, 87-113. Newbury Park, Cal.: Sage Publications, 1985.

Schwöbel, Chrisoph, and Colin E. Gunton, eds. *Persons, Divine and Human: King's College Essays in Theological Anthropology.* Edinburgh: T. & T. Clark, 1991.

Strawson, Peter F. *Individuals.* London: Methuen, 1959.

Taylor, Charles. *Sources of the Self.* Cambridge: Cambridge University Press, 1989.

Thoits, Peggy A., and Lauren K. Virshup. "Me's and We's: Forms and Functions of Social Identities." In *Self and Identity: Fundamental Issues*, ed. by R.D. Ashmore and L. Jussim, 106-33. New York: Oxford University Press, 1997.

Tillich, Paul. *Systematic Theology.* 3 vols. Chicago: University of Chicago Press, 1951-1963.

Varela, Francisco J., Evan Thompson, and Eleanor Rosch. *The Embodied Mind: Cognitive Science and Human Experience.* Cambridge, Mass.: MIT Press, 1991.

White, Vernon. *Paying Attention to People: An Essay on Individualism and Christian Belief.* London: SPCK, 1997.

Zizioulas, John D. *Being as Communion.* London: Darton, Longman & Todd, 1985.

______. "On Being a Person: Towards an Ontology of Personhood." In *Persons, Divine and Human: King's College Essays in Theological Anthropology*, ed. by Christoph Schwöbel and Colin E. Gunton, 33-47. Edinburgh: T. & T. Clark, 1991.

Endnotes:

1. Zizioulas, *Being as Communion*, p. 27. Italics in the original.

2. See Schwöbel.

3. Pannenberg, pp. 234-35.

4. Whatever one's opinion regarding the compatibility of theological and psychological approaches to the person, it is certain that the general incoherence of the topic is a problem for both disciplines. As Rom Harré notes, "The study of no aspect of humanity is so marked by muddled thinking and confusion of thought as this one" (p. 2). In sympathy with this perspective, Pfuetze proclaimed, "The problem of the self is perhaps the most elusive, abstruse, and subtle problem in philosophy. We know, or think we know, so much about man, about human nature – and yet we know so little. The terms we employ are names to cover our ignorance; they are abstracted descriptions which never give us the concrete wholeness of human lives nor explain the rich complexity of human experience" (p. 23).

5. Harré uses "person" to refer to "a human being as a social and psychological being, as a human organism having a sense of its place among others of its kind, a sense of its own history and beliefs about at least some of its attributes" (p. 73).

6. Harré, p. 73. Harré actually distinguishes between three specific interrelated descriptions of self, none of which, he argues, is individually adequate: all inhere in the person. Self, he supposes, can be described as a singular point of view, as the totality of personal attributes, or as how the individual appears to others.

7. One important caveat, though, must be firmly made at this point: the definitions offered above must be seen as specific to the Christian West, in the latter half of the twentieth century. Concepts of person have changed much over time: and those features of the person that are taken for granted in the modern western world, such as the extent to which they are attributed individuality or perceived to be personally autonomous, are not always so self-evident in pre-modern thought or in non-Western cultures. Although I am primarily concerned here with certain contrasts between contemporary Christian theological and psychological anthropologies, I am aware that those concepts are not necessarily representative of the whole gamut of person research.

8. I should emphasise that, as Lamiell notes, the concept of personal individuality is not necessarily derived from the philosophical doctrine of individualism. Indeed, many of the aspects of personhood that will be discussed here are essentially relationally derived. They are acquired and developed though participation in interpersonal relationships, and through the interactions with the physical world, which are a crucial part of human existence. A sense of individuality—roughly correlated with a person's impression of his- or herself as perceiving the world from a unique and singular point of view—is arguably a common denominator of all human persons in all cultures.

9. James is usually credited with introducing the self and identity as a subject of scientific analysis, as he was the first to suppose that it could be subject to the systematic rigorous empirical research procedures that, until then, were the preserve of the more traditional natural sciences. He developed the idea of a multiplicity of selves, though the apparent disunity of the self, soul, or person is not an original contemporary psychological discovery. Rather, it is an idea that is firmly grounded in many centuries of philosophical and theological tradition.

10. This hierarchy reflects his view that the material body is the foundation for all other selves and that the spiritual *self* is the apex of a person's individuality, comprising his or her "thoughts, dispositions, moral judgements, and so on, which he considered to be the more enduring aspects of the self" (Harter, p. 2).

11. James, *Principles of Psychology*, p. 294.

12. Furthermore, advances in empirical methodology, including more precise data-

gathering procedures and more sophisticated data-analytic methods, have reinvigorated the scientific study of the self, and research in this area has mushroomed in recent years. See, for example, Higgins; Hermans and Kempen; Bracken; Rosenberg.

13. The theory of the social construction of the self finds its most straightforward expression in Cooley's famous concept of the "looking-glass self"—the idea that one comes to know oneself only by assimilating the reactions of others toward oneself into a self-image.

14. Behaviorists and others have attempted to deny the efficacy of the "me," and many have quibbled over the precise mode of functioning of the "I."

15. Mead, p. 143.

16. According to Augustine of Hippo, the soul of the irrational outer man comprised the vegetative soul—the basic life giving principle common to man, animals and plants alike – and the animal soul, which includes those aspects of being common to man and animals such as sense perception. Augustine further divided the rational soul of inner man into the intellect and the will, which together comprised five further grades of being rising from discursive reason all the way to the intellectual contemplation of God. See *de Trinitate* XII.21-25, XIV.1-5.

17. See, for example, Zizioulas, *Being as Communion*, and "On Being a Person: Towards an Ontology of Personhood." See also Gunton and Schwöbel; and White.

18. McFadyen, p. 22.

19. Ibid.

20. Ibid., p. 27.

21. Ibid., p. 83.

22. See Bracken; Ashmore and Jussim; and Fletcher and Fitness.

23. Harré, p. 8.

24. Intuitively, from a folk-psychological perspective, self-unity is supposed to be conferred by a superordinate structure of the self – a substantive 'I' that organizes "me"—or through the continuity of consciousness in the manner proposed by John Locke and subsequently William James. These are now deeply unpopular approaches to the idea of unity, which raises as many questions as they answer, given how poorly consciousness is actually understood.

25. See McAdams.

26. See Epstein.

27. Although the mind remains effectively a society, Minsky argues, the concept of a self retains its utility, "provided that we think of it not as a centralized and all-powerful entity, but as a society of ideas that include both our images of what the mind is and our ideals about what it ought to be" (p. 23).

28. Rosenberg; Varela; and Minsky. This is not exactly a theory of unity, but more of a theory of how multiple selves might act as a sort of conglomerate entity, each retaining a degree of autonomy while recognizing the important roles that the other selves have to play in "wholeness" at a personal level. In fact, there is no compelling psychological reason for why the self *should* be unified at all. This, it will be argued below, represents another fundamental point of departure from theological conceptions of the person.

29. McAdams continues to trace this concept of a unifying process through much of psychoanalytic and cognitive psychology from Goldstein and Maslow to Jung and Piaget. See McAdams, p. 57.

30. McAdams, 1997.

31. McAdams, p. 56.

32. Ibid., p. 61.

33. Ibid., p. 60.

34. That one's prior experience has a significant influence on one's present experience—the "I"—needs no justification; it is the premise upon which the whole of psychology is predicated.

35. Including Polkinghorne; MacIntyre; and Hermans and Kempen.

36. Levinas, p. 36.

37. In fact, some, such as Varela, see no compelling psychological reason for why the self *should* be unified at all.

38. As Proudfoot suggests with characteristic clarity, "The issue can be stated quite simply. I am a son, husband lover, friend, competitor, citizen, colleague, and teacher. Each of these identities, which operate on different levels, contributes to my sense of myself. Sometimes they complement one another and at other times they conflict.... In every moment I forge an identity that integrates or pulls together all of these different roles into a sense of myself as a person. I think, I act, other persons respond to me, and I respond to their responses" (p. 21).

39. Pannenberg, p. 235.

40. McAdams makes the interesting point that "fragmentation" is a word that is not popular among psychologists. Whereas Mead and others were keen to celebrate the multiplicity of the self, "fragmentation" carries overtones of postmodern angst and uncertainty (McAdams, p. 53). When theologians use the word fragmentation to refer either to the psychology of the person or the place of the individual in community (for example, in the manner of White or Pannenberg), a similarly negative state of affairs is usually being implied. In these contexts, it is a word most often associated with "brokenness," "immorality," "conflicting," or "failure." This is, in turn, testament to the intrinsic value that theologians tend to place upon self-unity.

41. As Tillich argues, "selfhood or self-centeredness must be attributed in some measure to all living beings.... Man is a fully developed and completely centered self. He 'possesses' himself in the form of self-consciousness. He has an ego-self" (vol. 1, pp. 169-70).

42. White, p. 87.

43. Ibid., p. 95.

44. Millbank, pp. 424, 426; White, p. 98.

45. McFadyen continues, "The persons of the Trinity, for example, are identified by terms which indicate their most significant relations. Yet they appear in many more relations in a formally identical but materially different way. Hence the Father is identified principally in terms of the relation with the Son but has other relations less significant for, but consistent with, His relational identity and being" (p.40). John Zizioulas and Colin Gunton are of the same opinion and have similarly tried to argue that the concepts of substantial particularity and relationality can coexist in a concept of persons.

46. White, p. 104.

47. McFadyen, p. 100.

48. Ibid., p. 98

49. Pannenberg, pp. 234-35.

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